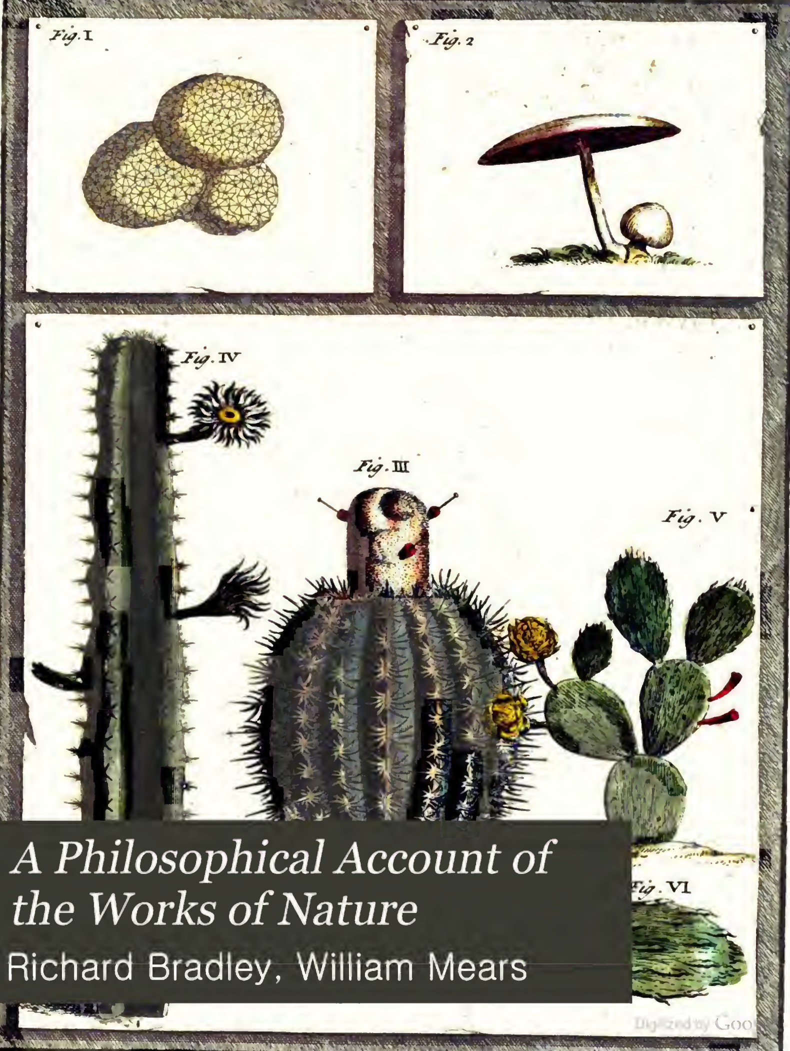

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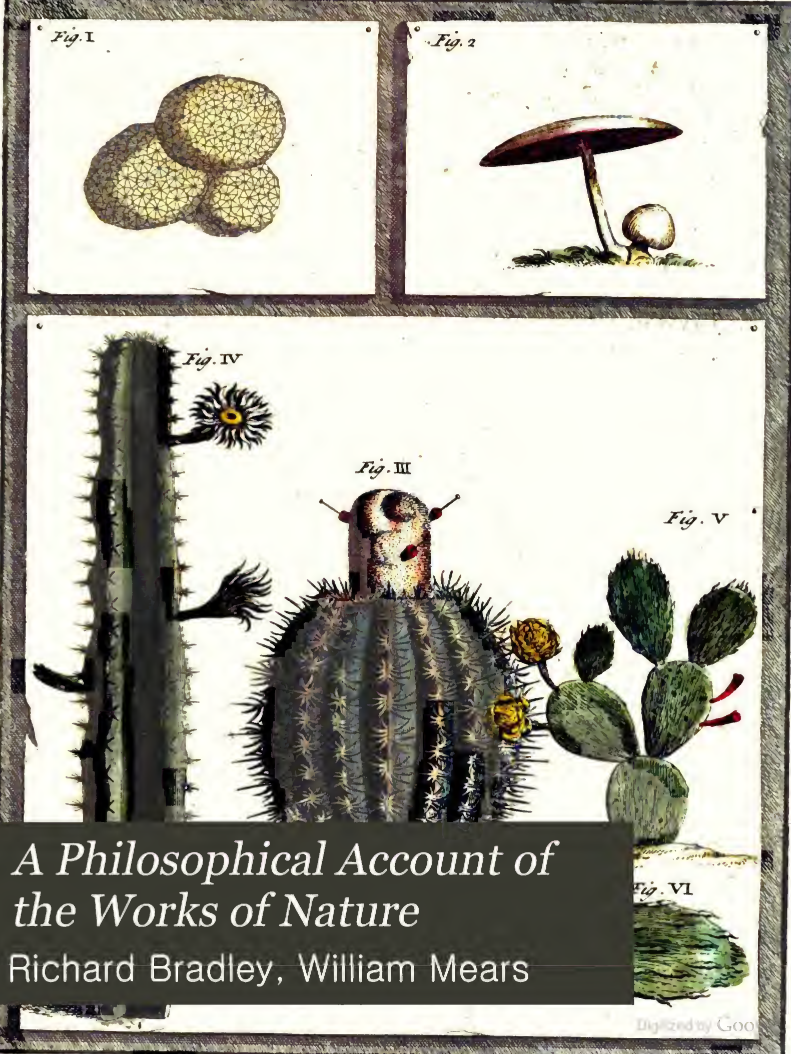
Richard Bradley, William Mears



A Philosophical Account of the Works of Nature

Richard Bradley, William Mears

A PHILOSOPHICAL ACCOUNT OF

WORK

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OF

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Endeavouring to ſet forth the ſeveral GRADATIONS
Remarkable in the

MINERAL, VEGETABLE, *and* ANIMAL
PARTS of the CREATION.
ending to the Compoſition of a SCALE *of* LIFE.

To which is added,

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and other Parts of *Europe*: Together with ſeveral new Experiments
relating to the Improvement of BARREN GROUND, and the
Propagating of TIMBER-TREES, FRUIT-TREES, *&c.*

WITH MANY CURIOUS CUTTS.

> *———All their known Virtue appears*
> *Productive in Herb, Plant, and Nobler birth*
> *Of Creatures animate with gradual Life*
> *Of Growth, Senſe, Reaſon—— ——* Milton.

By *RICHARD BRADLEY*,
Fellow of the Royal Society.

LONDON:
Printed for W. MEARS, at the *Lamb*, without *Temple-Bar*.
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To the Right Honourable the

EARL of *ORRERY*,

Knight of the Moſt Antient Order of the THISTLE, *&c.*

MY LORD,

YOUR Lordſhip's Approbation of the following Work, is ſufficient to gain it a favourable Reception with the Learned World; for as that Part of Mankind is Unanimous in Opinion of Your Lordſhip's Accurate Judgment in all Kinds of Learning; ſo whatever appears under

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And this, My Lord, is the Happineſs I reap from thoſe Labours which I deſign for General Uſe, to ſee them ſupported by ſo Noble and Learned a Patron; and to have the Honour of Declaring to the World in this publick Manner, that I am, with the greateſt Reſpect,

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Memorandum, read *Oviparous* for *Oviperous*; *Viviparous* for *Viviperous*; *Abricot* for *Apricock*; and *Oſteography* for *Oſteology*. The other litteral Faults I deſire the Reader to correct.

THE INTRODUCTION.

THE Great Mr. *Addiſon*, (whoſe Memory will ever be rever'd by the Learned and Curious Part of Mankind, for the excellent Leſſons he has given to the World) among other inſtructive Pieces, has ſo beautifully repreſented ſome of the Remarkables in Nature's Works; that it is reaſonable to believe a Continuance of his Life would have furniſh'd us with ſuch a Natural Hiſtory, as would have been uſeful to Men of all Kinds of Learning.

This Learned Gentleman, in his *Spectator*, N° 121, gives us his Opinion concerning Natural Hiſtory, in the following Words.

‘ I could wiſh our Royal Society would compile a Body of
‘ Natural Hiſtory, the beſt that could be gather'd together
‘ from Books and Obſervations. If the ſeveral Writers a-
‘ mong them took each his particular Species, and gave us a

'diſtinct Account of its Original, Birth, and Education, its 'Policies, Hoſtilities, and Alliances, with the Frame and 'Texture of its inward and outward Parts; and particularly 'thoſe which diſtinguiſh it from all other *Animals*; with 'their peculiar Aptitudes for the State of Being, in which 'Providence has placed them; it would be one of the beſt 'Services their Studies could do Mankind, and not a little redound to the Glory of the All-Wiſe Contriver.

I am proud to own in this Place, that it was Mr. *Addiſon* who firſt gave me this curious Thought, and lead me to the Compoſition of the following Treatiſe, which, however I have been fortunate in putting together, I can venture to affirm it conſiſts of Truth ſo far as I have mention'd any thing upon my own Knowledge. But as the World, in Caſes of this Nature, is commonly jealous of the Facts related, I have here given my Reader an Opportunity of ſurveying the ſeveral Curioſities I have mention'd, by directing him to thoſe Cabinets where each reſpective Subject is lodg'd.

It is not to be expected, that in a Work of this ſmall Volume, I can give a full Relation of the Exteriour and Interiour Parts of Bodies; nor can it be ſuppoſed that even it could contain the Names of every different *Mineral*, *Plant*, or *Animal* that is commonly known; for it is true (as Mr. *Addiſon* obſerves in the above-mention'd Paper) 'That a Natural Hi'ſtory, after all the Diſquiſitions of the Learned, would be 'infinitely ſhort and defective. Seas and Deſarts hide Mil'lions of *Animals* from our Obſervation; innumerable Artifi'ces and Stratagems are acted in the *howling Wilderneſs*, and 'in the *great Deep*, that can never come to our Knowledge. 'Beſides that, there are infinitely more Species of Creatures;

‘ which are not to be ſeen without, nor indeed with the Help of the fineſt Glaſſes, than of ſuch as are bulky enough for the naked Eye to take hold of. However, from the Conſideration of ſuch *Animals* as lie within the Compaſs of our Knowledge, we might eaſily form a Concluſion of the reſt, that the ſame Variety of Wiſdom and Goodneſs runs thro’ the whole Creation, and puts every Creature in a Condition to provide for its Safety and Subſiſtance in its proper Station.

From this uſeful Plan for Natural Hiſtory, I have endeavour’d to lay the Foundation of my Building, and ſhall account my ſelf happy enough, if among the Parts I have touch’d upon I have hit on any thing new and uſeful: I ſhall then be encouraged to proceed in my Obſervations and Experiments, and do my Part towards raiſing this noble Structure. In the mean while deſiring the Curious will aſſiſt all they can, in collecting ſuch Natural Materials, as may contribute to advance ſo beneficial an Undertaking.

A PHILOSOPHICAL ACCOUNT of the

WORKS *of* NATURE.

CHAP. I.

Of the moſt remarkable Appearances in EARTHS *and* MINERAL BODIES.

IN this Chapter I propoſe to treat of *Earths* and *Mineral* Bodies, ſuppoſing them to ſubſiſt much longer without any conſiderable Alteration of Parts, than any other of the Created Bodies. *Vegetables*, *Animals*, and *Inſects* have reſpectively their Modes of Growth very different from one another, each of them undergoing viſible Alterations till they are perfect; but *Earths* and *Mineral* Bodies require Length of Time to perfect themſelves in their reſpective Stations: Which time of their Tendency to Perfection I ſhall, for the Eaſe of ſome of my Readers, call the Time of their Growth.

What I ſhall here call *Earth* is whatever Soil I find in the Superficial and Second *Strata*, ſuch as may be uſed for the Propagation of Vegetables; perhaps in ſome Caſes we may even uſe the third *Stratum* for the Profit of Plants; but all the *Strata* below this I ſhall ſuppoſe are ſo many Beds of Mineral Matter, either in a ſtate of Solution, or Conſolidating, or elſe harden'd as much as they ever will be.

It would be tedious to enumerate every Particular which might be obſerv'd in all the Earths that are uſed for the Production of Vegetables; there are undoubtedly many thouſand different Mixtures, which have either been made deſignedly, or have happen'd by Accident. It will ſuffice for my preſent Purpoſe to diſtinguiſh them under three General Heads, as *Sand*, *Loam*, and *Clay*, for all Earths are in ſome degree or other partaking of theſe; and it is my Opinion that they all originally were made up of Sandy Particles, but vary'd only in their Powers, by mixing with Liquids of different qualities, (that is) ſuch as are *Aquæous*, *Viſcous*, and *Oleaginous*.

The Particles of Sand which compoſe Earth are not all of the ſame Dimenſions; ſome are big enough to be obſerv'd diſtinctly by the naked Eye, while others are ſcarcely to be diſcern'd with the Microſcope, yet every one of theſe Parts, however ſmall it is, may (I ſuppoſe) loſe of its Bulk and Weight, or add to both, by being expoſed to different Degrees of Heat; and ſo conſequently when many of them are united, that united Body will ſtill maintain ſo much of the natural Diſpoſition of the Parts it was compoſed of, that a certain Degree of Heat would have the ſame Effect upon it, that it would proportionably have upon the leaſt Particle of its Compoſition; for even a *Diamond*, which is the hardeſt *Gem* known in the World, will loſe a Share of its Weight by means of a powerful Burning-Glaſs; an Inſtance of which we find in *Phil. Tranſactions* N° 360, where in the Account of Experiments try'd with Mr. *Villette*'s Burning Concave in *June* 1718, by the Reverend Dr. *Harris* and Dr. *Deſaguliers*, we find that a Diamond weighing 4 Grains, loſt ſeven Eighths of its Weight, an Emerald was melted into a Subſtance like a Turquois Stone, the *Asbeſtos* ſeem'd condenſed a little in 28 Seconds, but it was then ſomething cloudy: Mr. *Villette* ſays that the Glaſs uſually calcines it. King *William*'s Copper Half-penny melted in twenty Seconds, Silver Six-pence in ſeven Seconds and a half, Tin melted in three Seconds, Caſt Iron in ſixteen Seconds, Slate in three Seconds, Tile in four Seconds, and vitrified thro' in eighty, Bone calcined in four Seconds, and vitrified in thirty three, *Calculus Humanus* calcined in two Seconds, Talk began to calcine in forty Seconds, and a Foſſile Shell in ſeven Seconds, Chalk fled away in twenty three Seconds.

N. B. *Mr.* Villette's *Mirour is a Concave of forty ſeven Inches wide, and ground to a Sphere of ſeventy ſix Inches radius, ſo that its Focus is about thirty eight Inches diſtant from the Vertex of the Glaſs.*

From whence it appears, that every Mineral or other Body, as it is more or leſs conſolidated or hardned, is more or leſs ſubject to the Impreſſions made by Heat or Cold; and this I mention the rather, becauſe I would offer the *Query*, Whether if theſe Parts of Sand, &c. being ſubject to dilate or contract, may not by means of their Pores receive a kind of nouriſhing or improving Juice from the next neighbouring Liquid, and by that help in a long Series of Years ſwell and become larger than we might ſuppoſe them at firſt? If this were allow'd, we might then ſuppoſe Mineral Bodies had a kind of Growth, and we might even hope to diſcover the Mode of Generation of Minerals or Stones; which Work, I am inform'd, the Celebrated *Malpighius* had began.

But further; take three Pound of Sand in three ſeveral Parcels, well dry'd, and make each Parcel into a Paſte, the firſt with common Water, the ſecond with ſome Viſcous matter, ſuch as a Solution of Soap and Water, or a kind of Liquid Soap, and the third with Oyl, and lay them for ſome time expoſed to the

Sun; the Sand and Water, as it dries, will fall to pieces, or ſeparate with a ſmall breath of Air; the Soap and Sand will be more retentive, and will not ſeparate without ſome difficulty; and the Oyl and Sand will be baked ſo hard, as to require a conſiderable Force to divide its Parts from one another.

I ſuppoſe then that the three ſeveral Soils I have mentioned, *viz. Sand*, *Loam*, and *Clay*, are all of them compoſed of Sandy Particles, but differently mixt with Liquids analogous to thoſe I have mentioned, and by that means are more or leſs binding.

All kinds of *Sandy Soil* are nouriſh'd with *Watery* parts.

Loam mixt with ſome *Viſcous* Liquid, and therefore more binding than Sand.

Clay mixt with *Oily* Parts, and therefore more binding than Loam.

And I the rather believe this, becauſe Water eaſily penetrates the Loam, and the viſcous Parts in it may be waſh'd away without difficulty; but Clay is more ſtubborn, and reſiſts the Water, which ſeems to demonſtrate that the Parts it is compoſed of are bound together by ſomewhat Oleaginous.

Chalk I take to be a certain degree of Clay whoſe Parts are more ripened; and Marle to be ſome undigeſted Matter, which length of Years would ripen and conſolidate.

I obſerve that neither Earths or Minerals are always conſtant, with regard to the Depth and Situation of their *Strata*, as we may ſee in ſeveral Accounts ſent to the Royal Society by ſome of their Ingenious and Learned Members. In *Phil. Tranſ.* N° 336, Mr. *Fettyplace Bellers* gives us the following Account of the *Strata* of Earth, Stone, *&c.* found in a Cole-Pit at the Weſt End of *Dudley* in *Staffordſhire*.

The firſt *Stratum* immediately under the Turff, a Yellowiſh Clay four Foot thick.

The ſecond, A Blueiſh Clay, five Foot thick.

The third, A Blueiſh hard Clay, called *Chinch* by Miners; it is one of the certain Signs of Coal. This *Stratum* is twenty four Foot thick.

The fourth, A Blueiſh ſoft Clay, nine Foot thick.

The fifth, A fine-grain'd Grey Stone, which is found in ſome Pits only, four Foot.

The ſixth, A Clay almoſt like the firſt, but whiter, twenty one Foot.

The ſeventh, A hard Grey Rock, ſeventy five Foot.

The eighth, A Blue Clunch, like N° 3, five Foot.

The ninth, A Black Subſtance, call'd the *Dun Row Batt*, one Foot.

The tenth, Coal, call'd *Bench* Coal, three Foot.

The eleventh, Coal, call'd *Slipper* Coal, leſs black and ſhining than the former, three Foot.

The twelfth, Coal, call'd *Spin* Coal, more black and ſhining, four Foot.

The thirteenth, A Coal by the Miners call'd *Stone* Coal, like *Canal* Coal, four Foot.

N. B. *Theſe* Strata *of Coal have, between each of them, a Batt as thick as a Crown Piece.*

The fourteenth, A Black Subſtance, call'd *Dun Row Batt*, the ſame with N° 9, one Foot.

The fifteenth, A hard Grey Iron Oar, call'd *Dun Row Iron Stone*, one Inch thick.

The ſixteenth, A Blueiſh Batt, (in which lies the following Iron Stone) call'd the *White Row*, three Inches.

The ſeventeenth, A hard Blackiſh Iron Oar, lying in ſmall Nodules, having between them a white Subſtance, and therefore call'd by the Miners *White Row Grains*, or *Iron Stone*, one Foot three Inches.

The eighteenth, A hard Grey Iron Oar, with ſome white Spots in it, call'd the *Midrow Grains*, two Inches.

The nineteenth, A Black fiſſile Subſtance, call'd *Gublin Batt*, two Foot.

The twentieth, A hard Blackiſh Iron Oar, with white Spots in it, call'd the *Gublin Iron Stone*, nine Inches.

The twenty-firſt, A Batt, in ſubſtance much like that in N° 19, one Foot ſix Inches.

The twenty-ſecond, A hard Grey Iron Oar, call'd *Cannoc*, or *Cannoc Iron Stone*, ſix Inches.

The twenty-third, A Batt ſomewhat harder than N° 21, one Foot.

The twenty-fourth, A dark Grey hard Iron Oar, call'd *Rubble Iron Stone*, ſix Inches.

The twenty-fifth, The Table Batt, next under the Rubble Iron Stone, two Foot.

The twenty-ſixth, A Coarſe Coal, call'd *Foot Coal*, one Foot.

The twenty-ſeventh, A Black brittle ſhining Batt, ſix Foot.

The twenty-eighth, The Heathen Coal, ſix Foot.

The twenty-ninth, A Subſtance like Coarſe Coal, by the Miners call'd a *Batt*, one Inch.

The thirtieth, The Bench Coal, two Foot.

The thirty-firſt, A Batt, ſix Inches thick.

This is as low as they generally dig, tho' there is a Coarſe Coal under this. We are to remark, that thoſe Subſtances which divide the *Strata* of Coals and Iron Oars, are call'd *Batts* by the Miners; they are generally black, conſiſting of a Matter peculiar to themſelves, and are of a Texture neareſt like Marle, tho' ſome of them are fiſſile, and others have a Subſtance not unlike Coal, mixt with them; it appears from hence that this Coal Mine is one hundred eighty eight Foot and a half deep.

The other Account is of the *Strata* obſerv'd in the Coal Mines of *Mendip* in *Somerſetſhire*, and communicated to the Royal Society by Dr. *Welſted*, in a Letter to him from *John Strachey*,

Strachey, Eſq; and inſerted in *Phil. Tranſ.* N° 360, in which we may obſerve that the Situation of the *Strata* are very different from thoſe in the Coal-Mine at *Dudley* above-mention'd. 'We find in the digging for Coal about *Mendip*,' ſays our Author, the Surface is moſtly a red Soil, which under the firſt or 'ſecond Spit degenerates into Malm or Loam, and often yields 'a Rock of reddiſh Fireſtone, till you come to four, five, or 'many times twelve or fourteen Fathom deep, when by degrees 'it changeth to a grey, then to a dark or blackiſh Rock, which 'they call the *Coal Clives*; theſe always lie ſhelving and regular 'as the Coal doth: But in theſe Parts they never meet with Fireſtone over the Coal, as at *Newcaſtle* and in *Staffordſhire*; theſe 'Clives vary much in Hardneſs, in ſome Places being little 'harder than Malm or Loam, in others ſo hard, that they are 'forced to ſplit them with Gunpowder; ſo likewiſe in Colour, 'the Top inclining to red or grey, but the nearer to Coal the 'blacker they grow; and where-ever they meet with them, they 'are ſure to find Coal under them. The firſt or uppermoſt Coal 'Vein at *Sutton* is call'd the *Stinking Vein*, it is hard Coal for 'Mechanick Uſes, but of a ſulphurous Smell. About five Fathom and half (ſeldom more than ſeven Fathom) under this, 'lies another Vein, which from certain Lumps of Stone mix'd 'with it, (like a *Caput Mortuum* not inflamable) call'd *Cats-head*, 'they call the *Cat-head Vein*. About the ſame Depth again under this lies the three Coal Vein, ſo call'd, becauſe it is divided 'into three different Coals; between the firſt and ſecond Coal is 'a Stone of a Foot, in ſome places two Foot thick; but the middle and third Coal ſeem placed looſe on each other, without 'any Separation of different Matter.

'Next under the three Coal Veins is the *Peaw Vein* ſo call'd, 'becauſe the Coal is figured with Eyes reſembling a Peacock's 'Tail, gilt with Gold, which Bird in this Country is call'd a '*Peaw*. The Cliff over this Vein is variegated with Cockle-

‘Shells, and Fern Branches, and is always an Indication of this Vein; under this again between five and ſix Fathom lies the Smiths Coal Vein, about a Yard thick, and near the ſame Depth; under that the Shelly Vein; and below that a Vein of ten Inches thick, which being little valued, has not been wrought to any purpoſe. Some ſay there is alſo another under the laſt, but that has not been proved within Man's Memory. At *Faringdon*, which lies four Miles diſtant from the Mines of *Sutton*, the *Strata* agree in all Parts.

‘Between *Faringdon* and *High Littleton* the ſame Veins ſeem to retain their regular Courſe; but at *Littleton* their loweſt Vein is the beſt Coal, which at *Faringdon* proves ſmall.

‘The ſame Veins are found again in the Pariſh of *Stanton Drew*, a Mile diſtant from *Sutton*, only at *Stanton* they have little of the red Earth or Malm on the Surface, but come immediately to an Iron Grit, or grey Tile-ſtone, which is a forerunner of the Coal Clives.

‘Now as Coal is here generally dug in the Valleys, ſo the Hills ſeem alſo to obſerve a regular Courſe in the *Strata* of Stone and Earth found in their Bowels; for in theſe Hills (I mean thoſe only that are diſpers'd between the Coal Works above-mention'd) we find on the Summits a *Stony Arable* mixt with a ſpungey yellowiſh Earth and Clay; under which are Quarries of *Lyas*, in ſeveral Beds, to about eight or ten Foot deep; and ſix Foot under that, thro' yellowiſh Loam, you have a blue Clay inclining to Marle, which is about a Yard thick; beneath this is a Yard of whitiſh Loam, and then a deep blue Marle, ſoft, fat, and ſoapy, ſix Foot thick, only at about two Foot thick it is parted by a Marchaſite, about ſix Inches thick; it is to be noted that theſe Beds of Stone and Marle run horizontal, whereas the *Strata* of Coal run ſlopewiſe.’ As it is very well repreſented in a Copper-Cut prefix'd to this Tranſaction, which I refer my Reader to, as well as the other curious Parts of that Epiſtle, which tho' they are not immediately uſeful to me in this Deſign, are nevertheleſs very well worth any one's while to read.

From theſe two Accounts, without enumerating the ſeveral Relations we might have recourſe to, we may ſatisfy our ſelves, that the ſeveral *Strata* of *Earths* and *Minerals* in Coal Mines, found in ſeveral Parts, even of *Britain*, are not always conſtant and agreeable one to another; and undoubtedly, when we dig for *Tin*, *Lead*, or *Copper*, the *Strata* found in thoſe Mines do not lie regularly the ſame in one County that they do in another: And even the hardeſt of them, at this Day, were once no more than thin Mud little denſer than Water; ſo that Bodies of no more weight than Shells, or Teeth of Fiſhes, would ſubſide themſelves down to the bottom, or lodge themſelves in it: We have Inſtances enough to prove this from the many kinds of Shells, Fiſh-bones, Bits of Plants and Animals found even in Bodies as hard as Marble, and almoſt every Quarry of Stone; which Shells, &c. could never have been there, if the Marble and other Stones they are found in had always been of the ſame Hardneſs.

But there remains a great Difficulty to determine, (*i. e.*) the length of Time neceſſary to ripen each reſpective kind of Mud, ſo as to bring it to the Hardneſs of Marble, Freeſtone, Fireſtone, &c. But if we examine the Account ſent to the Royal Society about four Years ſince, of a live Toad that was cut out of the middle of a Block of hard Stone, we may reaſonably imagine, that ſort of Stone could not be longer than an hundred Years, from its ſtate of Mud, to the time it was taken out of the Quarry, without we ſuppoſe that a Toad can live longer than an hundred Years. We have indeed an Inſtance of the ſpeedy conſolidating of Sand, Lime, and Water made into a Mud or Morter; and whether there may not be found ſome kind of Liquid to mix with Sand and Lime, which will make them more binding, and expedite their hardning, I leave to the Architects to conſider; but they muſt take this Thought along with them, that even ſome Waters are more petrifying than others; and that ſome kinds of Stone lying near the Surface are very hard when they are dug, but decay in a few Years when they are expoſed to the Air; while others, which are ſofter in the Quarry, grow hard and firm preſently after they are taken out of it.

Dr. *Stukely*, F. R. S. has very judiciouſly given his Opinion of this Matter, in a Letter to the Royal Society, concerning an Impreſſion of a Skeleton of a large Animal in a very hard Stone, call'd a *blue Clay Stone*, ſuppoſed to be dug out of the Quarries near *Fulbeck*. That Gentleman gives us, among other curious Remarks, the following Article: 'Sir *Iſaac Newton*'s Doctrine 'of the Attraction of the Particles of Matter, according to the 'quantity of its Solidity, Proximity, and Surface, eſpecially that 'it is infinitely greater in the point of Contact, upon which de-'pends its Coheſion, and all the Varieties of Phyſical Action, 'will eaſily direct us to a Notion of Petrifaction. We learn how 'a proper degree of Heat or Cold, Moiſture, Motion, Reſt and 'Time promote this Principle, from the common Experiments of 'Chryſtallization, and freezing even before the Fire, and in ma-'ny Chymical Mixtures. Whence we cannot be ignorant of 'Stone growing in the Quarries gradually, not by any fancied 'Vegetation, tho' there is ſomething like it in Corals, but ge-'nerally by Appoſition of Parts to Parts, as is notorious in the '*Fluors* of ſubterraneous Grots and Caverns; ſo that we have no 'reaſon to doubt, but what was *Clay*, *Sand*, or *Earth*, three 'thouſand Years ago, may now be *Stone* or *Marble*, according 'to the proportion of Concurrence of ſuch mention'd Cauſes.' The reſt of this ingenious Letter may be ſeen in *Phil. Tranſ.* N° 360.

In the above-mention'd Accounts of the *Strata* we find ſome Veins here and there of *Metalick* matter, as *Iron Ore*, for Example:

ample: Now whether at the retreating of the Waters to their appointed Bounds after the Deluge, theſe *Metalick* Bodies were equal in Quantity and Perfection, as we find them now-a-days, is a *Query* worth examining: Or whether from a few Particles or Seeds of *Metalick* Bodies falling into a proper *Nidus* they encreas'd or enlarged, or elſe, may we conjecture? That Parts of different Forms happening to mix with one another, agreeable to ſome Law of Nature, might with, or without the Aſſiſtance of ſome proper Liquid, frame a Body, which length of time ſhould ripen into a *Metal*; this, I think, deſerves our Conſideration. For my own part, I ſuppoſe that all the *Metals* now reſiding in the Bowels of the Earth, were not always ſubſiſting in the ſtate they are now in; I imagine they are abundantly increas'd ſince they were firſt created, by means of Seeds, or ſome method of Generating; and this, I think, is not more remote from Reaſon, than once the Generation of Plants was thought to be; and even from the firſt Principle of the Production of *Metalick* Bodies, to their moſt pefect State, I imagine they undergo various Alterations, and have different degrees of Ripeneſs, ſomewhat analogous to the Changes in Inſectal Bodies; as for Example, Let us take out of twenty ſeveral Mines of one ſort of Metal, which will yield Silver, an equal quantity of Ore, and refine every Parcel of that Ore diſtinctly, we ſhall hardly find two of theſe Mines produce the ſame proportion of Silver, or contain the ſame Richneſs one as the other, which I ſuppoſe happens, becauſe one is in a riper State than the other; perhaps that which is now Silver, was Lead, or ſome other Metal, a thouſand Years ago. We may yet add to this another Queſtion, Whether a *Metal* once generated in the Bowels of the Earth may not be help'd in its Growth, or nouriſh'd more or leſs, by means of Juices (mixing with it) filtering thro' the *Strata* above it of various Textures and Depths; for I ſuppoſe, as the ſeveral neighbouring *Strata* of Earths or Stone are variouſly compoſed or placed about the Vein of *Metallick* matter, ſo the Juices or Liquids filtring thro' them are of different Qualities, either nouriſhing to the Ore when they mix with it, or deſtructive to it: And I the rather embrace this Opinion, becauſe it does not ſeem diſagreeable to what the Learned Dr. *Woodward*, F. R. S. has laid down in his Celebrated *Natural Hiſtory of the Earth*.

I ſuppoſe likewiſe, that *Gems*, which are found in the Intervals or Cavities of the ſeveral *Strata*, proceed from certain Seeds, or fecundating Particles, of their reſpective kinds, which mixing with the Liquids continually filtring thro' the Pores of the ſeveral *Strata*, are by degrees brought into their Beds, (*i. e.*) thoſe Intervals amongſt the *Strata*, and are there Chryſtallized, and I ſuppoſe grow larger as they receive additional Encreaſe from the *Corpuſcules*, which continually are convey'd by the Water into them, and become more ripe or perfect, as they have a longer ſhare of time to lie there undiſturb'd. From the Experiment made on the *Emerald* with Mr. *Villette's* Burning-glaſs, whereby it was changed into a Subſtance like a Turquois Stone, and the other Obſervations there mention'd, we might alſo conjecture, that every particular kind of *Gem* requires a different degree of Heat or Cold to bring it to its true Conſiſtency and Colour; and then we may ſuppoſe, that while any *Gem* is firſt forming, and conſequently in a tender State, that then a little difference from the degree of Heat or Cold it naturally required would alter its Qualities; but Nature ſeems to have a ſpecial Regard to maintain them always in the ſame Degree, without Alteration, by placing them in the Bowels of the Earth, where (if I may ſo ſay) they always breath the ſame conſtant Air without Interruption.

As for *Pebles*, *Flints*, and ſuch like Stones, Dr. *Woodward* ſuppoſes them to have been all originally form'd and repoſed in the *Strata* of Earth and Sand; and even the *Amber* too, which that curious Gentleman makes a natural *Foſſile* as well as the reſt; and the Reaſons he gives why we find ſo many of them looſe on the Sea-ſhoars, and on the Surface of the Earth, is, that by violent Waſhings of Rains, and by the Sea or other Water beating upon the Shores, Cliffs or Lands, the Earthy Parts are diſſolved and carry'd away; but the *Pebles*, *Pyritæ*, *Amber*, or other like *Nodules*, being hard, and not diſſoluble, and more bulky and ponderous, are left behind, diveſted of their Terreſtrial Covering. And indeed I do not find the Growth or Encreaſe of ſuch like Bodies can be accounted for any other way, than by ſuppoſing them to have had their firſt Being in the Bowels of the Earth, where they might be regularly ſupplied with every thing neceſſary for their Conſtruction and Nouriſhment; and again, it is ſo much more obvious, as we find every ſort we can name, as well lying in *Strata* under Ground, as expoſed upon the Shores and Surface of the Earth. And the Nouriſhment and Difference of Colours given theſe Bodies, while they were lying and growing in their ſeveral *Strata*, I ſuppoſe to be produced by a Cauſe, nearly the ſame of that which gives us the different Colours in the Leaves and Flowers of Vegetables; the ſeveral Strainers or Veſſels which compoſe Plants, doing perhaps the ſame Office that the ſeveral *Strata* of Earths do to Minerals or Metals; and as the different Juices paſſing thro' the ſeveral Veins or Beds of Earth are alter'd by a ſort of Filtration, and varied by mixing with ſome Mineral Corpuſcules, which would be latent without ſuch Aſſiſtance; ſo theſe Juices differently ſtrain'd thro' the ſeveral kinds of Earth, mixing with ſome Vegetable Particles, which change their Qualities, produce difference of Colours in the Leaves and Flowers of the Plants they paſs through.

And this is what I ſhall venture to mention at preſent concerning *Earths* and *Mineral* Bodies, which, if my Conjectures are right, have a kind of *Growth*, and even a mode of Generating and Increaſing; and if once we have ſufficient Proof of theſe, we need not ſcruple to allow them *Life* too, however ſlow it be;

theſe indeed have no *Local Motion* no more than Plants; but Animals that have *Local Motion* are yet analogous to Plants in *Generation* and *Circulation* of Juices thro' their Bodies, and have *Senſation* more than Plants: Plants then want *Local Motion* and *Senſation* to be equal to Animals; but I ſuppoſe have only the Powers of *Viſible Growth* more than Minerals, and of being tranſplanted from place to place, and yet retain the Power of *Growth*; but where muſt we tranſplant the Earth to make it grow, or improve it?

CHAP. II.

Of the CORALINE, TRUFFLE, FUNGUS, SPONGE, *and ſuch Bodies which poſſeſs the firſt Degree of Vegetative Life, and are ſeemingly the Paſſage between Minerals and perfect Plants.*

IN the foregoing Chapter I take notice (as far as my Experience will permit) of *Mineral* and *Metallick* Bodies, that they poſſeſs a certain Share of Life, or kind of Growth, whereby they attain to diſtinct degrees of Perfection, as they have lain more or leſs time in their natural Beds; the *Stones* which I have in the laſt place taken notice of, have each, according to its Tribe, a Figure or Form, which diſtinguiſhes it from one of another Claſs; and the length of time which Nature takes to form them, gives them at leaſt an equal ſhare of time to remain unperiſhable; ſo it is likewiſe obſervable in *Vegetables*, that as they are more ſlow of Growth, ſo is their Remain of longer Duration; but I conceive there is not in Nature any *Vegetable Body* which can or ever had half the Durance of *Minerals*, unleſs *Coral* may be allow'd low'd its place among Vegetables: And it is the different Sentiments of our great Men concerning this Subject, which gives me ſome difficulty in this Part of my Work. It is not allow'd by ſome to be more than a *Petrified Body*, while ſome Gentlemen of the Royal Academy at *Paris* pretend to have diſcover'd its *Seed Veſſels*, as we may find in their Memoirs for the Year 1711. For my own part, I ſhall not pretend to determine ſo great a Difficulty, unleſs I had more Experience in the matter. I ſhall only take notice from its branch'd Figure, and its manner of faſtning it ſelf to Rocks, Stones, and Shells, that it has ſome Analogy to Plants; for in the firſt place, if we conſider the *Coralines* frequently growing upon our *Engliſh* Coaſts, the manner of their rooting in *Stones* and upon *Oyſter-ſhells*; their method of Branching, and cruſted Subſtance, I cannot ſee any reaſon why we may not place *Coral* amongſt the *Submarine* Plants. Again, as to the rooting of *Coral* in this manner, and the poſſibility of its drawing Nouriſhment from Bodies of ſo hard a Nature, let us look upon the *Sea-belts*, which ſometimes are of that Length and Extent, that I have meaſured ſeveral above ſix Foot long, altho' the Stones they were rooted in did not weigh above a Pound a-piece: So likewiſe the *Sea-Weeds*, and *Fuci*, have not always larger Bodies to draw their Nouriſhment from; but indeed they may probably be aſſiſted in their Vegetation by the frequent Returns of the Sea Water, which may ſerve to fill their more ſpongey Parts, and contribute to make 'em ſwell, as the Circumambient Air aſſiſts the Growth of *Land* Plants Moreover, we find that *Coral* is of different Kinds or Species, as much as any Plant growing upon the Land; we have the Red, the White, and the Black, pretty common, beſides many other more rare Sorts in the Cabinets of the Curious, where I commonly find them accompanied with *Coralines*, the *Sea-Fan*, and other ſuch like Bodies.

The famous Cabinet of Mr. *Vincent* at *Harlem* abounds in theſe Rarities; as does alſo that of the curious Dr. *Frederick Ruyſh* of *Amſterdam*, where I have ſeen near ſixty Sorts remarkably different from each other; eſpecially in the firſt curious Collection is to be admired a large Branch of the red Coral, above a Foot and half in height, of an extraordinary Value. There is indeed one thing which we may take notice of, with regard to *Coral*, that upon breaking off any part of a Branch, we diſcover the ſame Star-like Shootings as are found in the *Star Stones*; and there is ſeemingly wanting thoſe capillary Veſſels which run longitudinally, to convey the Sap up the Stems of Plants, nor do I find by Enquiry with my beſt Microſcopes that they have any, which is much the ſame caſe with the Leaves of the *Aloë*, and ſome other kinds of *Succulent* Plants, where we cannot diſcover any Veſſels which run longitudinally thro' them, and are therefore brittle as Glaſs The famous Mr. *Leeuwenbock* of *Delft*, who was juſtly reckon'd the greateſt Man in *Europe* for his Skill in Microſcopes, has given the World a curious Account of his Obſervations on red Coral, in a Letter to the Royal Society, wherein, I think, are ſeveral Remarks which may greatly contribute to illuſtrate this Work, and help to determine whether it is more a Mineral or a Vegetable; he tells us that he has ſeen ſmall Parts of the red Coral upon a little *Scollop Shell*, and upon a ſmall Fiſh call a *Horn*, and was of Opinion that it did not grow on thoſe Bodies, but was only coagulated upon the ſaid Shells. He then proceeds to give us an Account of his Microſcopal Obſervations, and tells us that he cut off ſeveral thin ſcaley Particles, both Longitudinally and Horizontally, from the Blood Coral, in order to diſcover the Veſſels in them; he obſerves, that in thoſe Parts which he had cut thro' a-croſs, there ran ſuch Fibres from the Center to the Circumference, as are found in the Roots of under-ground Fruits; but that in the other Parts he had only a feint View of ſome very ſmall Orifices of Veſſels, and could make no perfect Remarks of them, but that it ſeem'd to him as if the Parts of *Coral* were made up of roundiſh Particles, ſuch as ſome certain Fruits are compoſed of; but their Roundneſs was not exactly equal one to the other, but ſuch as might beſt ſuit with the reſt, ſo as to leave Vacuity in them; (*I ſuppoſe like the Bubbles in Froth of Liquors*) and thus, ſays he, the Saps which are not in the Veſſels, are convey'd from one of thoſe round Parts to the other, and ſo ſerve for Canals.

‘Again, he ſuppoſes that *Coral*, whilſt it is growing at the Bottom of the Sea, is very ſoft, and that the Plants of *Coral* or their Branches being broken off by the *Coral* Fiſhers, the thick Ends of them may accidentally fall upon a *Stone* or ſome other Subſtance; and by reaſon of their Softneſs, and a Glutinous Matter they are endued with, may very eaſily be faſten'd to the *Stone*, and then give us reaſon to believe it is an Excreſcence from the *Stone* or other Subſtance we find it upon.’ From this laſt Obſervation, as well as the former, I do not ſee any reaſon why we may not place *Coral* among *Vegetables*; for as I've remark'd before, that the Brittleneſs of *Coral* may proceed from the ſame Cauſe as that does in the Leaves of *Succulent* Plants, *i. e.* the want of Longitudinal Veſſels, ſo may the *Coral* partake of other Properties common to *Succulent* Plants, ſuch as that if we only lay upon the Earth an Off-ſet or Branch of *Aloe* or *Sedum*, they will ſtrike Root in due time without other trouble; and Shells and Stoney Subſtances being to the *Coral*, as the *Earth* is to the above-mention'd Plants, a broken Piece may as well take Root upon them, as the others do upon the Earth.

The *Sponge* is the next which we may conſider as a Subject leading to Vegetation, and is what I believe is allow'd by all to be a Plant, tho' it is indeed ſeemingly imperfect, if we compare it with others; but its Veſſels are ſo nicely woven into one another, that every part is equally ſupply'd with Juices as it ſits, or is driven from place to place upon the Sea; it is a Wanderer as well as the *Lens Paluſtris*, or *Duck Meat*, which ſeldom or never fixes its Roots in any ſolid Body, but ſtrikes them into the Water only, from whence it receives its Nouriſhment. The Figure of the *Sponge* is for the moſt part Globular, but without any great Exactneſs; it is compoſed of Parts rather like the *Pith*, than any other part of a Plant, is wanting of Leaves, and has not either Flowers or Fruit that I can yet diſcover. There are relating to the *Sponge* ſeveral kinds of *Spongoids*, which are ramoſe or branch'd; but the Texture of their Parts are near the ſame with the common *Sponge*.

The next following theſe, and but little more perfect, ſeemingly, either in Figure or Parts, is the *Truffle* and the *Puff-balls*. The *Truffle* is of two Kinds, as Mr. *Tournefort* informs us, the one round, and the other of an Egg-like Figure; but the fleſhy part of both theſe kinds is of a much cloſer Texture than the *Sponge*, and each of them grow commonly about ſix Inches under Ground in the Woods of *Italy*, *France*, and ſeveral Parts of *England*, and I am inform'd have their *Seed-Veſſels* towards the Center, in the moſt fleſhy Parts; but as yet I have not been able to diſcover any, but refer my Reader to the Account given of this Tribe of *Plants*, by the Curious Mr. *Geoffroy*, in the *Memoirs of the Royal Academy of* Paris, 1711. I am apt to believe the *Truffle* is not unlike the *Puff-Ball*, as to its manner of *Growth*, that is, in the firſt place its Fleſh is pretty firm, and by degrees, as it becomes more ripe, its inner Parts change to a kind of *Duſt*, as we find in the *Puff-balls*, which grow ſo plentifully upon Commons and other Paſture Grounds; whoſe *Duſt* I ſhould rather ſuppoſe to be the *Seed*, than be inclin'd to look for it in them while they are in their growing State. Of the *Puff-balls* I have likewiſe obſerv'd one ſort growing in the ſhape of a Pear, commonly under Crab-trees.

After theſe we muſt take notice of thoſe of the *Fungus Tribe*, which are yet without Caps, but ſeeming more conſtant and regular in their Figure than thoſe we have already mention'd. There are two kinds which reſemble Branches of *Coral*, they are common in the Moſſey Grounds in *England*, and differ only in the Colours of Yellow and White. After them the *Cup Muſhrooms* cut on one ſide, ſuch as the *Fungus Sambucinus*, or that which is found growing about the Roots of the *Elder-tree*, and ſome others nearly ally'd to it, which are of an *Orange* Colour.

Next follows thoſe kinds of *Fungi* with *Stems* and *Caps*, which vary their Figures as they become more replete with Juices; theſe begin to ſhew us ſome Parts, which we may naturally expect to find in *perfect Plants*, as *Roots* and *Veſſels*, which run longitudinally, and compoſe the *Stem*, from whence the *Cap* receives its Nouriſhment till it is fully explaned, as may be eaſily diſcover'd in the common *Muſhroom* or *Champignion*, without the help of a Glaſs, as well at its firſt Appearance in the *Button*, as when its *Cap* is fully ſpread; the *Chives* within ſide of the *Cap* have been by ſome taken for the *Seed*; but I do not find, with the greateſt Care, they can ever be made to Germinate.

As to the *Champignion*, which is ſo much eſteem'd for its excellent Flavour and delicious Reliſh, it is propagated with great Facility in the Gardens about *Paris*; but the Gardeners there have no regard to the *Chives* which I have before mention'd; nor do they believe there is any ſuch thing properly as *Muſhroom* Seed, but chiefly rely upon the manner of making Beds for them, and placing here and there in thoſe Beds ſmall pieces of Moldy Soil, found commonly in old Dunghills, which is accounted better, as it abounds with white Cobweb-like Veins running through it. And it is obſervable that the Moldy Soil I mention, after lying three or four Days in the Bed, becomes as it were a Leaven to the whole, by ſhooting out its Cobwebs over the greateſt part of the Surface, and at length runs into Cluſters of ſmall white Knots, which come in the end to be perfect *Muſhrooms.* To make theſe Beds, they provide three or four Cart-loads of Horſe-dung, well clear'd from the Straw, and toſs it up in an Heap to lie for fifteen Days; then they mark out their Bed three Foot wide, and of that length as may employ the Dung to lie near a Foot and half thick, laying the Sides ſloping, in ſuch a manner, as that the Top of the Bed may be brought to a Point or ſharp Edge, like the Ridge of a Houſe, when it comes to be raiſed three Foot high, which muſt be done with Dung, prepar'd like the former fifteen Days, after the firſt making or laying of the Bed.

Immediately after the firſt Layer of Dung is wrought it muſt be cover'd, the Top and Sides with Horſe-litter to lie upon it undiſturb'd, till we lay on the ſecond or laſt Courſe of Dung, and then the whole Bed muſt be coated an Inch thick, with fine Earth, and beat down gently with a Spade, having a ſtrict regard where the Line runs between the two different Layers of Dung, along which there muſt be bury'd about an Inch deep ſome ſmall pieces of the Moldy Soil as big as *Wallnuts*, at a Foot diſtance, and then the whole carefully cover'd with Horſe-litter; from this Management we may expect a large Quantity of *Muſhrooms* in a Fortnight after the Bed is compleated, and will continue to produce every Day for a Month or five Weeks.

In the gathering of this Dainty, the *French* Gardeners always take care to pull them up with their Roots, preſſing the Earth down gently upon the place they draw the *Muſhrooms* from, and covering it with the Litter immediately; they are likewiſe very curious to obſerve, that no broken part of a *Muſhroom* be left on the Bed, which would breed Worms, and deſtroy the young Knots of *Buttons*, which are coming forward. In the Winter they lay up great Parcels of the Moldy Soil in dry places, for their Uſe at different times; and they have this regard to the

Plate. I.

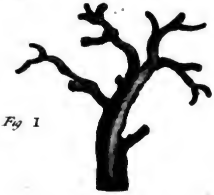


Fig. I

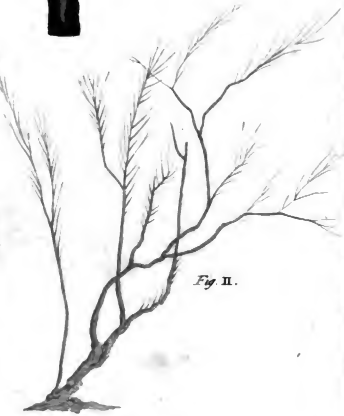


Fig. II.

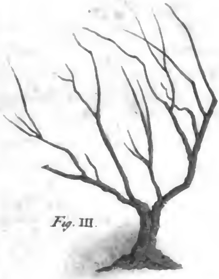


Fig. III.

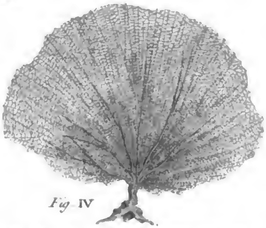


Fig. IV

J. Cole sculp.

making of their Beds in the Summer, that from *May* till *September* they lay the Foundations of them eight or ten Inches below the Surface of the Earth.

Of theſe *Cap Muſhrooms* there are ſome more ſubſtantial, others more fugacious, ſome edible, others poiſonous; but to take them together they are a very numerous Family. The curious Mr. *Dandridge* (to whom I've been obliged for many Notes and Obſervations mention'd in this Work) has now by him the Paintings or Figures of above a hundred Sorts, which he has collected in *England*; and I am perſwaded that there is hardly any Nation which does not afford as many different kinds in proportion, conſidering the Drawings I have ſeen in the curious Cabinets abroad. The Times of their natural Growth, is in the Spring, and in the Autumn.

We may note, that the Moldineſs upon Liquors, and ſuch as appears upon Confections and Pickles that are damaged, is of this Tribe: They are multitudes of ſmall *Fungi* or *Muſhrooms*, which are of that quick Growth, that in about fifteen Hours one ſingle Point will ſpread a quarter of an Inch over the Surface, as I have obſerv'd with the Microſcope.

Explanation of the Figures relating to this Chapter.

PLATE I.

Fig. I. *A Branch of the* Red Coral.
Fig. II and III. *Branches of* Coralines.
Fig. IV. *The* Sea-Fan.

PLATE II.

Fig. I. Truffle.
Fig. II. *The* Button *of the* Muſhroom, *with its Plant fully perfected.*

CHAP.

CHAP. III.

Of PLANTS *and* SUPER-PLANTS, *what is moſt remarkable in them.*

THE former Chapter gives us an Account of thoſe Vegetables which ſeem to be the moſt imperfect, as to their want of Parts; but they are indeed more ſpeedy in their Growth than thoſe Plants which have the uſual Ornaments of Leaves, Flowers, and Fruit, or ſuch as we ſhall find treated of in this Chapter. *Muſhrooms* however are certainly perfect as to themſelves; but the more common Knowledge of *Trees*, *Herbs*, and *Shrubs*, may give us room to think, that whatever Vegetable is wanting of the Ornaments theſe poſſeſs is not perfect. For my own part, I think it no ſmall Pleaſure that Nature is ſo extenſive and variable in her Works, that a bare Diſcovery of them is more than the whole World can compaſs; and that the Mind of Man, which naturally loves Novelty, has the grateful Opportunity of being placed in the midſt of ſuch a boundleſs Variety. With regard to Life and Growth, the Unskilful are apt to judge, that Parts of the ſame Kind muſt equally reſide in all created Bodies; but if I may venture to give my Notion concerning that caſe, it is, that what every Vegetable or Animal is wanting of half the Parts or Ornaments that we find in others, thoſe ſeemingly *Imperfects* have a double Power of acting from every Part they contain, ſo that two Parts in them perform as much as four in the others; which may perhaps be the reaſon that *Muſhrooms* are of quicker Growth than thoſe *Plants* which we ſtile the moſt *Perfect*.

The *Plants* which I think moſt properly follow the Tribe treated of in the foregoing Chapter, are firſt, the *Ruſh* Kind, or *Juncus*, of which there are many ſorts, ſome larger, others leſſer, which chiefly diſtinguiſhes one Kind from another, all of them conſiſting of green ſpiral Stems, which reſpectively bring forth Bunches of Flowers that end in Seed, but have no Leaves; they may be rather accounted *Amphibious* Plants, than Inhabitants of the Waters, ſeeing that they grow as well on the Land, if it be tolerably moiſt, as in the Waters.

Theſe may be ſucceeded by the *Echinomelocactus*, or *Melon Thiſtles*, which are *Plants* without Leaves, and are only guarded with *Thorns*; the *Melon Thiſtles* never branch, unleſs they are cut, as I have obſerved in two kinds of them: the large ſort which comes commonly from *Nevis* and St. *Chriſtophers* in the *Weſt-Indies*, by loſing its Top or Crown, puts forth young Heads, which may be taken off and planted for Increaſe; and ſo likewiſe the ſmaller kind, which comes from the *Cape of Good Hope*, will do the ſame; the firſt of theſe I have ſeen in the ſtate I mention, in the Royal Gardens at *Hampton-Court*, and the latter in the Phyſick Garden at *Amſterdam*, from which Place I got ſeveral young Plants. It is remarkable, that in both theſe the Bloſſoms barely appear through the Skin or Covering of the *Plant*, and the Fruit always remains hid within the *Plants* till it is full ripe, and then burſts forth on a ſudden, which is not common in other *Plants*. Theſe two are deſcribed in Mr. *Ray*'s *Hiſtoria Plantarum*, and in the *Hortus Lugduno Batavus*, and are ready Engraven for my Hiſtory of *Succulent Plants*.

The next following is the *Torch Thiſtle*, a *Plant* of an extraordinary Face; it is wanting of Leaves, but in other Reſpects coming nearer the Perfection we look for than the former; theſe flinging out their Branches freely; they are all guarded with *Spines*, and bear large Star-like Bloſſoms, which do not open till the Fruit is full grown, after the manner of the *Opuntia* or *Indian* Fig: The largeſt kind of them is that which we have ſo common in our Green-houſes in *England*, and is engraved in the firſt Decade of my *Hiſtory of Succulent Plants*; this I have ſeen near twenty Foot high in the Royal Garden at *Paris*; and in the Royal Gardens at *Hampton-Court* there is another ſort with a white Rind or Skin, which, like the former, grows upright, but with leſs Luxuriance. The firſt of theſe I call *Cereus erectus Maximus Americanus hexangularis, flore albo radiato*, or, *Great Upright Torch Thiſtle:* The ſecond, *Cereus Americanus Octangularis Spinis albicantibus*, or, *Great White Torch Thiſtle.* At the Phyſick Garden at *Amſterdam* they have three or four different Kinds of the *Upright Cereus*, which I have not ſeen elſewhere; of this Tribe there are likewiſe ſome *Creepers*, which are jointed and run upon the Ground: Their Thorns are commonly ſmall and tender, and the young Shoots are for the moſt part furniſh'd with voluntary Roots, which lay hold of the *Earth* or *Barks* of Trees as they happen to fall. One ſort has a Triangular *Stem*, the other has its *Stems* ſix rib'd. The firſt is engraved in my firſt Decade of *Succulent* Plants, the other I deſign for the third; to theſe we may join the *Euphorbium*, and ſome other *Tythymals*, which are yet without Leaves; they ſhoot their *Stems* upright, are guarded with *Thorns*, and differ from the foregoing *Plants*, in having a Milky Juice, and Flowers and Fruit of ſmall regard. Dr. *Comelin* has given us very good Cuts of many of them in his *Hortus Amſtelodamenſis*.

The *Plant* next following the *Euphorbium* is the *Opuntia* or *Indian* Fig, which is the firſt *Plant* that attempts to make Leaves, but in ſuch a manner as may eaſily ſlip the Obſervation of the Curious. Mr. *Rand*, F. R. S. a moſt ingenious and learned *Botaniſt*, was the firſt who informed me of them; they appear only upon the young *Stems* whilſt they are perfecting their Growth, and afterwards are ſupplanted or followed by Knots of *Spines*. Of this Tribe I have about thirteen ſorts growing in *England*, which I deſign to deſcribe in my Decades of *Succulent* Plants; they are all very full of Juice and Pulp, ſhooting *Stem* out of *Stem*: 'Tis from one of theſe Kinds that the *Indians* gather the *Cochineal*, which I ſhall mention at large in its place.

The *Fig-Tree* may next follow the *Opuntia*, as the Fruit is always perfected in its Parts before the Bloſſom is to be found. What I mention concerning the Bloſſom of the *Fig*, or manner of its Flowring, I have not my ſelf yet ſeen; but take the Account from my Friend Monſieur *Geoffroy*, of the Royal Academy at *Paris*, who has given a large Deſcription of the Flowers of it in the *Memoirs of the Royal Academy of Sciences at* Paris, *for the Year* 1712. That Gentleman, upon the foot of what Mr. *Moreland*, my ſelf, and ſome others, have advanced, concerning the Generation of *Plants*, or the manner of ſetting their Fruits, has given a large Account of ſuch Parts of Bloſſoms in the *Fig* as are neceſſary in Nature to perform the Office of Generation; he tells us, that all the Parts required to do this Work are within the Fruit of the *Fig*, thoſe which are Female lying towards the bottom of the Fruit, and the *Apices* or Male parts, which produce the *Farina fecundans*, are ſituate towards the Top; he has given us very good Figures of them in general, and in particular, both from natural View, and with the Microſcope, which I ſhall leave my Reader to examine; and in the mean while, as I have had occaſion to mention ſomewhat relating to the Generation of *Plants*, I ſhall entertain my Reader with a curious Eſſay upon that Subject, which was communicated to me in the Year 1719, by that excellent Phyſician Dr. *Antoine de Juſſieu*, Profeſſor of *Botany* at the King's Gardens at *Paris*, Entitled,

The Analogy between Plants and Animals, drawn from the Difference of their Sexes.

THAT *Plants* and *Animals* are analogous, we may believe, if we only conſider the manner whereby they receive their Nouriſhment. That ſort of Life which the antient Philoſophers obſerv'd in *Plants*, was accounted by them ſo nearly the ſame with that in *Animals*, that they did not ſcruple to call it a *Soul*, but has ſince been more reaſonably term'd *Vegetation*.

The Compariſon which has been made between the Structure and Uſe of the *Bark* of *Plants*, with the *Skin* of *Animals*; of the *Tubes* through which the *Sap* is convey'd through the *Trunk* to the *Extremities*, with the *Arteries* and *Veins*; the Reſemblance of the Ramifications of thoſe Chanels, with the *Blood-Veſſels* and *Lymphaticks*, has given Occaſion to *Ceſalpinus* and other illuſtrious Authors amongſt the Moderns, who have ſtudy'd the *Anatomy of Plants*, to eſtabliſh this Syſtem.

We may yet advance this Opinion much farther, if we conſider the Nature of *Plants*, and how they may be diſtinguiſh'd as *Terreſtrials*, and *Aquaticks*, and thereby agreeing with the *Animal* Kingdom. We may alſo compare the Solidity and Duration of *Woody* and *Vivaceous Plants*, with the Strength and Length of Life in *Quadrupedes*. We may likewiſe obſerve the Similitude between the *Capillary* and *Fungous Plants*, and the ſhort Remain of ſuch as are *Annual*, with the Imperfections attributed to *Inſects*, and the Shortneſs of their Lives: And to this we may add another Remark, That among *Plants* there are two ſorts of *Aquaticks*, which, like Fiſh, are either diſtinctly Inhabitants of the Salt or Freſh Waters.

As there are *Amphibious Animals*, ſo is the *Vegetable* Kingdom alſo furniſh'd with *Plants* that have Parts which live as well out as within the Waters.

But as theſe general Obſervations, which are founded upon the Structure of the *Organs*, and upon the Mode of *Growth*, have been already diſcuſs'd by ſo many Phyſicians, that there is no room left for Doubt, I ſhall make it my Buſineſs to eſtabliſh another kind of Agreement betwixt *Plants* and *Animals*, by more particular Obſervations, drawn chiefly from the Diverſity of

Sexes, and from the Conformity and Uſes of thoſe Parts which are to be diſtinguiſh'd in them, for the perpetuating their Species.

It appears that the Antients had ſome Notion of this Diſtinction of Sex among *Plants*, as we find in their Writings that ſome have given the Quality of Male, others of Female, to certain *Vegetables*; but the more I have taken pains to examine into the Reaſons they had to eſtabliſh this difference of Sexes, ſo much the more I find them out of Reaſon; eſpecially when I diſcover that they have given the Feminine Character to ſome *Plants* for the ſake of their beautiful Flowers, or from the Port or Appearance of the whole *Plant*, as in the *Peony* and ſome others, or elſe they had eſtabliſh'd the Maſculine Gender from the Conformation of the *Roots*, *Fruits*, or *Seeds*, as they were nearer the Reſemblance of the Male Parts of Generation in *Animals*, as in the *Orchis*, *Mercury*, *Hemp*, &c.

But the Chief of the modern *Botaniſts*, *Malpighius*, *Grew*, *Ray*, and *Camerarius*, have greatly improv'd upon the Hints given by *Ceſalpinus*, by marking out to us in a particular manner the Diſtinction of Sexes, in the Deſcription of certain Parts which do thoſe Functions.

I ſhall not in this place enter upon the late Propoſition of Meſſieurs *Geoffroy* and others, who in the Deſcription they give us of the ſeveral Parts of a Flower, tell us, that the *Duſt* which falls from the *Apices* of Flowers is the *Germ* of the *Plant*, or *Embrion* of it, ſince this Syſtem is ſubject to the ſame Difficulties with that of the Generation of *Animals*, ſuppoſed to be affected by the *Worms* or *Animalcules* in the Male Seed.

Nor do I pretend to aſſign any Reaſon why Nature has obſerv'd ſo much Regularity in ſo many different Figures, as we find in the *Farina* of each reſpective kind of *Plant*, with the help of *Microſcopes*, ſince Dr. *Grew*, who was ſo careful in his Obſervations of this Nature, and Monſieur *Geoffroy*, who is a diligent Follower of that ingenious *Engliſhman*, have neither been able to find them out.

I ſhall only take upon me to compare the Exteriors of *Plants* with *Animals*, as far as it regards their Sexes, wherein this Difference of Sex in *Plants* conſiſts, and the manner of obſerving it.

As the *Flower* is that part of a *Plant* which contains the *Organs* for its Generation, it is neceſſary to determine what Idea we ought to have of it, and not to fall too haſtily into the enormous Opinions of ſome who believ'd with *Malpighius*, that their moſt eſſential Parts were no more than *Viſcera* appointed for ſeparating the Excrementitious Juices.

I am of Opinion, that what we ought properly to call the *Flower*, is the Aſſemblage of little Threads, to which the *Botaniſts* have given the Name of *Stamina*; and are terminated at their *Tops by ſmall Caps or Purſes* call'd *Apices* or *Chives*, which generally have double Openings, from whence flies out the fine *Duſt* which ripen'd in them.

The *Stamina*, which I have juſt now mention'd, are either encompaſs'd by a ſingle or double Furniture, either of one, or of many Pieces, conſiſting of one or of various Colours, which have hitherto been call'd *Leaves*, but may rather bear the Name of *Petals*, to diſtinguiſh them from the common Leaves of *Plants*, which are generally green, as well as thoſe which ſerve for an outward Coat to the *Petals*, and known by the Name of *Calyx* to the Flower.

Theſe *Stamina* encompaſs, for the moſt part, a Body of a different Figure, either ſingle or compoſed, which is either the *Embrio* of the Fruit, or a *Tube* terminating like a Trumpet, to either of which the Name of *Piſtillum*, or *Piſtil*, is indifferently given.

This Deſcription I conceive is exact and full enough to give us a quite different Idea of the *Flower* than what we have hitherto ſo receiv'd, and may oppoſe the vulgar Opinion that every *Body* of various-colour'd Leaves is a Flower or Bloſſom; inſtead of which, the curious Obſervers of Nature cannot miſs the Obſervance (beſides the *Petals*) of all the other Parts which we have juſt now mention'd; and from the Inſtant they behold them, muſt of neceſſity perceive their Uſes from their Structure and Diſpoſition, but more eſpecially when they have Opportunity of obſerving their ſeveral States and Changes at different Times.

We may conclude then that the Secret of Generation is neither to be found in the Root, Trunk, or Leaves of a *Plant*, but only in the Garniture of thoſe *Organs*, which we have obſerv'd the *Flower* is compoſed of: Since we do not find in any other part of *Plants* thoſe *Organs* which ſo well agree with the Parts of Generation in *Animals*, or are ſo uſeful and neceſſary to perpetuate their Species. It ſeems as if Nature, who has hid from us her manner of Working in the Generation of *Animals*, is more enclin'd to open that Myſtery to us in the *Vegetable* Kingdom, ſince the Means ſhe makes uſe of, with regard to Generation of *Plants*, is more open, and may be more eaſily obſerv'd.

In effect, what can more reſemble thoſe *Organs* which conſtitute the Male-Sex in *Animals*, than thoſe which characteriſe the ſame in *Plants*? What Agreement is in their Functions! Thoſe little *Caps* which make the *Chives* of the *Stamina*, the *Farina* which they encloſe, and is ſo exquiſitely prepared as a proper Matter for fecundating the *Germe*; and again, thoſe Trumpet-like *Tubes*, which are ſtiled *Piſtils*, ſituate in the Center of the *Stamina*, for the more eaſy Reception of the *Duſt*, which is the Off-ſpring of the *Apices* or *Chives*, the Springs which open them, and the manner of their flinging abroad this prolifick *Duſt*: Do not theſe ſufficiently ſet forth the beautiful Simplicity which Nature obſerves in her Works?

If we could find modeſt Terms to expreſs the Care and Precaution which Nature takes to ſucceed in her Work of Generation in *Animals*, what Agreement and Uniformity ſhould we not find with that ſhe makes uſe of in the Generation of *Plants?* The Uſefulneſs of the *Petals* which encompaſs the *Apices* to preſs them towards the *Piſtillum*, ſo that their *Duſt* may fall in great Abundance into it; as likewiſe how neceſſary they are to protect thoſe tender Parts from the Injury of the Wind, may ſtill afford us freſh Matter of Admiration.

It is eaſy to judge, from the Function of the *Piſtillum* which receives this *Duſt*, that it does the Office of the Parts of Generation in the Female *Animals*; and that what we have before obſerv'd, as far as the Intromiſſion of the *Duſt* into the *Piſtillum*, agrees well enough with the Conception of the *Fœtus*.

The Nouriſhment and Growth of the *Embrio* Seed after its *Germe* is made fecund, is agreeable to the Growth of the *Embrio Animal*; the Fruit which encloſes it, whether it be *Membraneous*, *Ligneous*, &c. or whether it be in the Form of a *Capſule*, *Cod*, or *Siliqua*, or is divided into few or many Cells or Lodgments, that Fruit (as *Malpighius* obſerves) ſerves as a *Matrix* to the Seed.

From this Deſcription of the Parts of a *Flower*, and the Obſervations upon their Uſes, we may draw two Conſequences.

The firſt is, That thoſe Parts in *Plants* which may be term'd *Flowers*, are thoſe which perform the Office of Generation.

Secondly, That after the ſame manner that in the *Animal* World we diſtinguiſh between the *Males*, *Females*, and the *Androginous*, we likewiſe diſcover thoſe Diſtinctions of Sexes in *Plants*, which Dr. *Grew* has already touch'd upon.

We may then conclude that a *Plant* may be termed *Male*, when its *Stamina* do not encompaſs any *Piſtil* or *Stile*, or that the *Stile*, if it has any, is barren, or does not encloſe an *Embrio* Seed: Of this kind, are thoſe Strings or Bunches of Flowers which we call *Catkins*, or *Julii*, and the falſe Bloſſoms of *Hops*, *Hemp*, *Mercury*, and ſome others.

On the contrary, the *Female* is eaſily known by its *Piſtils* or *Stiles*, which are not encompaſs'd by *Stamina*, but only guarded with *Petals* or other *Membranes*; and yet are fecundated by the *Duſt* of *Male* Flowers, which either grow upon the ſame *Plant*, or upon others of the ſame Race. This *Fecundation* is done by the help of the Wind, which conveys the prolifick *Duſt* into the *Tubes* of the *Piſtils*, when they are advanced to a fit State to receive it, as it is obſervable in the *Wallnut*, *Hazle*, *Alder*, *Willow*, *Coniferous* Trees, and *Gourd* kind. *Malpighius* obſerv'd theſe two Diſtinctions in the *Flowers* of the laſt mention'd *Tribe*, as we may remark, by the Figures he has given of them in his *Anatomy of Plants*.

The certain Mark by which we may diſcover the *Androginous* Flowers, is the ranging of the *Staminas* about the *Piſtillum*, whoſe *Baſe* or *Body* becomes a Fruit; ſince we have already remark'd, that the *Staminas*, which are the *Male* Parts, will fecundate the *Piſtils* in the ſame *Flower*, which Part we have obſerv'd is found only in the *Female*. There is this only Difference between the *Plants* and *Animals* that are *Androginous*; *Plants* accompliſh their Generation in themſelves without the help of another Individual of the ſame *Tribe*; and the *Animals*, altho' they are endow'd with *Organs* agreeable to both Sexes, are yet obliged to ſeek for one of their own Race to couple with. *Plants* for the moſt part bring *Flowers* of this laſt Species, (that is to ſay) ſuch *Flowers* as end in Fruit.

This Diſcovery is the Fruit of thoſe Obſervations which have been made in the *Anatomy of Flowers and Fruit*, ſince it has been judg'd neceſſary, that thoſe Parts of *Plants* were the moſt proper to eſtabliſh their Characters; and 'tis not to be doubted but that Time and Induſtry may diſcloſe to us *Organs* of the ſame Uſes in thoſe *Plants*, which have been ſtiled hitherto *Imperfect*, and which will no longer bear that Character when their Sex ſhall be determin'd.

We cannot in common Juſtice refuſe to give the Honour due to *John Baptiſt Porta*, for having firſt obſerv'd the *Seeds* in certain *Plants*, which, till his time, were eſteem'd barren, as in the *Truffle* and *Muſhroom*, which has ſince been confirm'd by the curious Remarks of Monſieur *Geoffroy*, Junior; thoſe of Monſieur *Marchand* on the *Agaricus digitatus niger*; and thoſe of Monſieur *le Comte de Marſigli* upon the *Lytophyton*, in whoſe *Bark* he has found the *Seed*; and we begin likewiſe to diſcover them in many *Marine Plants*, but chiefly in the *Fucus*.

Monſieur *Billerer*, Profeſſor of Phyſick at *Bezançon*, informs me that he has even diſcover'd *Seed* in a River *Sponge*, call'd *Spongia ramoſa fluviatilis*.

There is room to believe, that if we were to take a little Pains to examine the *Marine Plants* at different Seaſons, we might diſcover their *Flowers*, or ſuch Parts as acted for them, ſince Monſieur *de Reaumur* and Monſieur *Michaeli*, *Botaniſts* to the Duke of *Florence*, have already diſcover'd certain Parts which might reaſonably be eſteem'd Dependants of *Flowers*.

This Diſtinction of Sexes being eſtabliſh'd in *Plants*, is one of the moſt conſiderable Marks of the Analogy between *Plants* and *Animals*; but as it is not only by the Difference of Sexes, nor by the Uſe of the *Organs* of Generation, that we preciſely characteriſe the different *Animals*; ſo neither muſt we be perſwaded that theſe Differences in *Plants* can contribute to diſtinguiſh their ſeveral Tribes; for in many *Plants*, thoſe Parts which mark out the Sex are not eaſily diſcover'd; and in others the *Flowers* are of ſo ſhort Durance, that we are not always happy enough to find them in a right Condition for Obſervation.

Thus my Friend concludes his curious Obſervations relating to the Difference of Sexes in *Plants*, which might very properly be follow'd by the Eſſays upon their manner of Generating, written by my ſelf and others, wherein there are many Particulars which would render this Subject more inſtructive; but as they are already made publick, I ſhall refer my Reader to 'em in the *Memoirs of the Royal Academy of* Paris, *for the Years* 1711, and 1712; and my ſecond Chapter, in my firſt Part of *New Improvements of Planting and Gardening*, &c. Indeed, ſince they have been abroad, I have had Opportunity and Time enough to make farther Diſcoveries, and thoſe perhaps may not be unacceptable in this Place; as for Example: With regard to *Freſh-water Plants*, we may obſerve of the *Nympheas* or *Water-Lillies*, and the *Potamogatons* or *Pond-Weeds*, (which I have chiefly obſerv'd) that in their Act of Generation, or time of Flowering, the Bloſſoms always appear above Water till the prolifick *Duſt* is ripe, and caſt abroad; and as ſoon as that is over, and the *Piſtillum* or *Rudiment* of the Fruit thereby impregnated, it bends it ſelf downwards till it is entirely under Water, and grows ripe in that State. Again, I obſerve that their *Seeds* always ſink to the Bottom when the Fruit is ripe enough to open it ſelf, which ſhews us the Care that Nature takes to ſend every *Seed* to its proper *Matrix*; for theſe *Plants*, however their Leaves may appear to ſwim upon the Waters, yet their Roots have always hold of the Ground below. We muſt not however imagine that every ſort of *Water Plant* is faſtned by its Roots to the Earth at the Bottom of the Rivers or Pools where they grow: Both kinds of the *Lens Paluſtris*, or *Duck-Meat*, wander from place to place upon the Face of the Waters, without touching the Bottom either with their Roots or other Parts; and I think the *Water Soldiers* do the ſame: But that may be enquir'd into by ſuch as live about the *Fenns* in the *Iſle of Ely*, where they abound

But it is time I return to my firſt Propoſition and chief Deſign of this Work, *i. e.* to mark out, if poſſible, the ſeveral Gradations in Nature's Works, and what Analogy there is between one Part and another; which leads me to the Conſideration of thoſe *Plants* that are very viſibly endued with all the

Parts required in *Vegetables*, viz. *Roots*, *Trunks*, *Bark*, *Pith*, *Branches*, *Leaves*, *Flowers* and *Fruit*; and they are of three Kinds, *Herbs*, *Shrubs*, and *Trees*.

An *Herb* is properly that *Genus* of *Plants*, whoſe *Stalks* periſh every Year, and whoſe *Foliate* or naked *Roots* put forth every Spring their freſh *Flower-Stalks:* Of theſe are the *Graſſes*, *Primroſe*, *Auricula*, *Pink*, *Tulip*, *Ranunculus*, *Anemony*, *Strawberry*, &c. and theſe are either *Fiberous* or *Tuberous* rooted, or elſe have *bulboſe*, *apple*, or *knotted Roots*; and may again be diſtinguiſh'd by being *Annual*, or *Perennial* and *Vivaceous*. Moreover, the ſeveral Modes of Growth which Nature has diſtinctly given to the ſeveral kinds of *Herbs*, are well worth our Obſervation; the firſt are the *Dwarfs*, ſuch as the *Auricula* and *Polyanthos*, or *Cowſlip* Kinds, which ſubſiſt without Props or Supporters, and form their Off-ſets or Increaſe in Cluſters cloſe about the old *Roots:* The ſecond are *Dwarfs* likewiſe, as the *Strawberry* and *Violet*, which increaſe by ſending out jointed Strings from the main *Plants*, that at every Knot take Root as they run along the Ground. The third ſort is of thoſe *Plants* which are *aſpiring*, but have not Strength of Body to ſupport themſelves without Stakes or Props, which they twine round about, as the *Convolvulus*, *Phaſeolus*, and ſome others, which are ſo ſtrongly impell'd by Nature to twiſt about and embrace every thing that happens to be near them; that as the Loadſtone attracts Iron to it, ſo have I ſeen *Plants* of this ſort change their firſt Deſign of Growth from one Point of the Compaſs to another, to lay hold of Stakes that have been ſet a Foot diſtant from them. The fourth is the *Gourd*, and the *Pea* kinds, which want the Power of twining, and yet have not Strength enough to ſupport themſelves; but Nature has provided them with other Means of bearing themſelves from the Ground, having furniſh'd them commodiouſly with *Claſpers*, which catch hold of every thing they can come near; theſe

Claſpers, tho' they do not lay hold of the Ground about them to act there as *Roots*, yet I am of Opinion they are not only deſign'd for bearing up and binding the *Plants* they are related to to Props, but ſerve likewiſe to draw a kind of Nouriſhment from the Air, which their Mother *Plants* could not live without, and are in that reſpect analogous to thoſe *Roots* which we find at every Knot of the *common white Water Ranunculus*, which in the Summer only ſtrike into the Water, and undoubtedly receive Nouriſhment from it, tho' they have always a main *Root* which ſtrikes deep into the Ground: Theſe *Roots* are, in Appearance, like the Leaves of *Fennel*, and are ſo very green, that they have given us ſome room to believe the *Plant* had Leaves of two kinds; but if we conſider this *Plant* a little farther, we may obſerve that it generally grows in ſtanding Pools or Ditches, which about the End of Summer are vacant of Water, and then is left upon dry Ground, where theſe *Fennel*-like *Roots* take faſt hold, and produce *Plants* for the next Year. We may alſo take notice that they are *Amphibious*, living as well upon the Land as in the Waters, which is common likewiſe to the *Minths* and ſome others. And it may be remark'd, that the *Roots* of this *Ranunculus* are perfectly form'd before the Water leaves 'em to ſhift for themſelves to get their Living in a new Element, and are till that time in a manner ſuckled by the Mother *Plant*.

A *Shrub* is that Genus of *Plants*, which in every Circumſtance, but in its Bigneſs and Duration, imitates a *Tree*; it has Branches of a Woody Subſtance, and is *Perennial:* Of this Race are *Gooſberries*, *Myrtles*, *Furze* or *Gorſe*, *Meſereon*, *Roſemary*, *Lavender*, *Thyme*, &c. tho' ſome who are over-nice in their Diſtinctions eſteem the latter as *Under-ſhrubs:* The *Shrubs* however, without that Diſtinction, may be reckon'd of four ſorts, *viz.* ſuch as are compleat *Buſhes*, and are able to ſupport themſelves without Props, as the ſeveral kinds of *Roſes*, *Althea Frutex*, *Goosberry*, *Caper*, &c. which laſt is ſo rare in *England*, that I cannot help taking notice of it in a particular manner, having my ſelf brought it to Perfection in *England* without the trouble of Hot-beds or Green-houſes; and I believe was the firſt that has made the *Caper* familiar to our Climate. 'Tis now about four Years ſince my Friend Mr. *Balle* of *Camden-Houſe* receiv'd ſome *Caper* Seeds from *Italy*, which I then ſow'd in the Scaffold Holes of his Garden-Walls, to imitate as near as poſſible the Method of their Growth about *Toulonne*, and at the ſame time put ſeveral of the *Seeds* into a Hot-bed; the Conſequence was that thoſe which were ſown in the Wall-Rubbiſh ſhot near ſix Inches the ſame Summer, and the few that came up in the Hot-bed were ſcarce three Inches high the firſt Year, altho' they were houſed with the tendereſt Exotick *Plants*, and thoſe in the Walls ſtood the Winter without Shelter. The ſecond Year thoſe *Plants* in the Walls made Shoots of a Foot in length, while thoſe in the Pots hardly added two Inches to their height. The third Year in *April* I cut the Shoots of the foregoing Summer from the *Plants* that were abroad, leaving only a Bud or two of each near the original *Stem*, which the ſame Summer made Shoots near three Foot long, to the number of about Forty upon each *Plant*, and put out Buds for Bloſſoms, but the *Plants* in the Pots did not advance above two Inches. In ſhort, the laſt Year one ſingle *Plant* in the Wall had not leſs than a quart of Bloſſom-Buds upon it fit to pickle, and the *Plant* perfected ſome of its Fruit. Thus if the *Plant* be headed down in the Spring like a *Willow*, it will every Summer make a beautiful *Buſh*, and afford us as good *Capers* as grow in *Italy*.

The ſecond Race of *Shrubs* are ſuch as have a natural Tendency to twining or twiſting their Shoots about Props, as the *Hony-ſuckles* or *Wood-binds*, and *Jeſſamines*, &c.

The third ſort have *Claſpers*, which take hold of every neighbouring Twig or Stake to ſupport their rambling Branches, and thereby are defended from the Injuries they might receive by high Winds and Storms: Of this kind is the *Vine*, and the *Maracoc* or *Paſſion-Tree*.

The fourth kind of *Shrub* is that ſort which Nature has furniſh'd with ſuch Tendrils (for Climbing) as ſtrike their Points into the *Bark* of *Trees*, and which I ſuppoſe help to nouriſh the *Plants* they proceed from, as well as to aſſiſt them in their Climbing; and I the rather believe they draw ſome Support from the Juices of the *Trees* they ſtrike into, becauſe the *Trees* they grow about ſeldom or never make ſuch vigorous Shoots as others that are clear of them: Of this kind is the *Ivy*, and *Virginia Creeper*, with ſome others.

A *Tree* is that ſort of *Plant*, which of all others is the moſt lofty in its Growth, and has its Parts more robuſt, firm and laſting than any kind of *Plant* yet mention'd; and to theſe its Perfections we may add, that it enjoys a longer Share of Life than any other *Vegetable*; and thoſe chiefly among *Trees* are of the longeſt Laſt which are of the ſloweſt Growth.

Among *Trees* we may make the following Diſtinctions.

Firſt, The *Pomiferous*, or *Apple*-bearing, as the *Apple*, *Orange*, &c. which have their *Seeds* in *Pippins*, or *Kernels*, in the Center of their *Fruit*.

Secondly, The *Pruniferous*, or *Plumb*-bearing, as *Plumbs*, *Apricocks*, *Peaches*, &c. which are call'd *Stone Fruit*, and carry but a ſingle *Seed*, cover'd with a thick hard Shell in each *Fruit*.

Thirdly, The *Nuciferous*, or *Nut*-bearing *Trees*, as the *Wallnut*, &c, which differ from the foregoing, in bearing *Katkins* and *Female* Bloſſoms at Diſtances one from another upon the ſame *Trees*; they bear one ſingle *Seed* or *Nut* in each *Fruit*, which, like the former, is cover'd with a hard Shell, and upon that has commonly a Coat of a fleſhy Subſtance.

The Fourth kind of *Tree* is *Coniferous*, or *Cone*-bearing, as the *Firr*, the *Pine*, the *Cedar* of *Libanon*, &c. whoſe *Cones* are of a hard woody Subſtance, containing a ſingle *Seed* under each of their *Squammæ*.

The laſt I ſhall take notice of are thoſe which are *Glandiferous* and *Maſt*-bearing, ſuch as the *Oak*, *Beech*, *Aſh*, &c. which all have their *Seeds* encloſed in ſingle Shells, without Fleſh or Pulp upon them.

We may remark in the next place, that a *Tree* is a Body on which is dependant many Kinds of Vegetable Bodies; the firſt are thoſe which cannot ſubſiſt without it, or get Nouriſhment ſufficient to maintain themſelves elſewhere. The ſecond are ſuch as may be taken from it, and made ſo familiar with the Juices of the Earth, that they ſtrike Root and Vegetate, till they become as perfect *Plants* as the Originals they were taken from.

The firſt *Vegetative* Bodies or *Plantulæ*, which more immediately relate to the *Tree*, are the *Stamina* with their *Apices*, found in the Bloſſoms; theſe are for the moſt part like ſo many *Fungi* taking Root in the Foot-ſtalk of the *Flower*, or elſe in the Bottom of the *Calyx*: Their Office is to impregnate the *Stiles* of the Bloſſoms with the *Farina* they produce; and as ſoon as they have done that Work they fade and drop off. We may ſee one of theſe *Stamina* with its *Apex* and *Root* done by the Microſcope, at the End of my third Part of *New Improvements of Planting*, &c.

The *Petals* or *Flower* Leaves are alſo *Plantulas*, almoſt of the ſame kind; their Office, as we have already obſerv'd, is to guard the tender *Organs* of Generation from Cold and other external Injuries; theſe alſo having perform'd their Work drop from their *Mother Plant*: The longeſt of their Life (as well as that of the *Stamen*) is two Months.

In the next place we come to conſider the *Viſcum* or *Miſletoe*, which is always a *Super-plant*, and can never be made familiar enough with the Earth to take Root, or grow in it; and can only be propagated, by ſticking the *Seeds* upon the *Barks* of *Trees*,

Trees, into which it ſtrikes its *Roots*, and ſupplies it ſelf with Nouriſhment from their *Sap*: The manner of its making its firſt *Roots* from the *Seed*, is, by ſending out from its Center three *Claws*, which fix themſelves on the *Bark* of the *Tree* in the three Points of a Triangle, and are at their Extremities like the Mouths of *Leeches*, when they are diſpoſed for drawing in their Nouriſhment; theſe faſten themſelves to the *Bark* of the *Tree*, and begin to ſeparate at the Center of the *Seed*, as if each *Claw* was to become a diſtant *Plant*; but a Year or two makes us know the contrary; the three *Claws* are then ſwoln or enlarged enough to meet at their Root-points, and are ſo ſtrongly united together, that they make the Foundation but of one *Plant*; and the place of their firſt joining in the Center of the *Seed* opens, and divides, ſo that there appears three diſtinct Branches ſpreading from the *Root*; after this it proceeds to bloſſom, and bear Fruit, and will live to a great Age. It is remarkable that there is but one ſort of *Miſletoe* in *England*, notwithſtanding that which grows upon the *Oak* has been the moſt admired; and I don't find but that the *Miſletoe* of *Apple-trees*, or any others, have the ſame Parts with that of the *Oak*, and have alſo the ſame Vertue; for the *Plants* which the *Miſletoes* grow upon ſerve only to them, as the Earth does to any *Herb* that is planted in it, that is, to furniſh it with a convenient Supply of Nouriſhment. And I have not yet obſerv'd that the Phyſicians have made any Diſtinction between particular *Plants* growing upon *Sand*, *Clay*, *Gravel*, or *Chalk*, &c. becauſe, as I ſuppoſe, they think a *Plant* ſtill preſerves its original Vertue, let it grow in any Soil; but this will admit of many Diſputes: We know that half a dozen *Grafts* or *Cions* of the *Golden Pippin* may be engrafted upon as many different ſorts of *Trees*, and yet the Properties of the *Golden Pippin* ſtill preſerve themſelves in all the *Grafts*, tho' they have different kinds of Nouriſhment from their ſeveral Stocks; but an *Oak* planted upon a dry Hill will not ſhoot a third part ſo much as another of the ſame kind will do in Clay or a moiſt Bottom; and the Difference of the Grain of their Wood, or Size of their Veſſels, are in proportion to the Growth of thoſe *Trees*, from whence we may judge that the Juices filter'd through the ſmall *Tubes* of one *Tree*, muſt be twice as fine as the Juices paſſing through the large *Tubes* of the other; and then a *Cube* of an Inch taken out of the Solid in the ſmall *Tree*, muſt contain a different proportion of Vertue, from a *Cube* of the ſame Dimenſions taken out of the larger *Tree*; but this Caſe I ſhall treat of more at large in ſome other place.

But I cannot leave the *Miſletoe* without taking notice of two Things: In the firſt place, as to its Method of Growth, the ingenious Dr. *Douglas*, F. R. S. has made ſeveral Capital Diſcoveries, which he has communicated to the Royal Society, and is yet ſo obſervant in the Progreſs of that *Plant*, that we expect he will oblige us with further Obſervations. On the other hand, (after it has been conſider'd botanically) I have the Happineſs to ſay my worthy Friend Sir *John Colebatch* has given us a generous Account of its Vertues, and, with the true Spirit of a *Briton*, has put the Key of Life (as I may call it) in the Hands of thoſe who are troubled with the worſt Diſtempers, I mean Epileptick Caſes, which ſometimes lead Men to that Extravagance, that in former Ages they have been eſteem'd as mad Men, People bewitch'd, or poſſeſs'd with Devils. And theſe deplorable Circumſtances of Mankind may have given Occaſion to two Things which are very remarkable; Firſt, That when the *Druids* lived they had the Knowledge of Diſeaſes that were incident to Human Bodies, and had the Knowledge of the *Miſletoe* in this caſe, by which they might probably appear as Demi-gods in the Eyes of the People. Secondly, That the *Oak*, which was held as ſacred by them, was chiefly the *Tree* that the *Miſletoe* grew upon; not to mention the other good Qualities of the *Oak*; and from hence it may be likewiſe, that by Tradition the *Miſletoe* of the *Oak* is now in Eſteem beyond the reſt.

We are next to conſider ſuch *Moſſes* as are found growing upon the *Barks of Trees*, and chiefly upon ſuch as are diſtemper'd and declining in their Vigour; for it can hardly be ſaid that a healthful *Tree* ever produces any *Moſs*. The *Moſſes* which are the greateſt Sign of ill Health in *Trees*, are the *Cup Moſs*, and ſome others which branch like Corel Lines, and a third ſort reſembling a Bunch of Wool: Theſe are all white, and bear *Seeds*, but are not in other reſpects ſo perfect as the *Green Moſſes*. The Time of their Shooting is in *October*, when the Rains begin to fall.

We come now to treat of ſuch *Vegetable* Bodies as are depending upon *Trees*; but may nevertheleſs be made ſo familiar with the Juices of the Earth, that from a ſingle part of a *Tree* they become *perfect Plants*. The firſt of theſe are the *Leaves*, which contain in themſelves ſuch *Vegetable* Principles, as give them a Power of producing as *perfect Plants* as the Originals they were taken from. For inſtance, Plant the *Leaves* of *Orange Trees*, or other Ever-greens, in freſh Earth, they will ſtrike Root, and produce *perfect Plants*, if they are well water'd and kept in the Shade, as my ſelf and Mr. *Thomas Fairchild* of *Hogſdon*, with ſome others, have experienc'd; ſo that the *Leaves*, beſides their Uſe in helping the *Buds* to germinate while they are growing upon the *Trees*, may be then eſteemed perfect *Vegetable* Bodies. The *Leaves* of *Aloes* being ſet in like manner will produce *perfect Plants*; and even the *Fruit* of the *Opuntia* or *Indian* Fig, when it is full grown, being ſet into the Earth, will ſtrike Root and become a *Plant* as *perfect* as the *Mother* it was taken from: By this Method I have often ſaved ſeveral *Plants*.

The *Twigs* and *Branches* of *Trees* are really ſo many *Plants* growing upon one another; for as they all proceed from *Buds*, or may rather be ſaid to be *Buds* explained, we may thence infer that the *Buds* they came from did in every reſpect perform the

Office of a *Seed:* The *Twigs* take Root in the *Branches*, and the *Branches* take Root in the *Stem.*

It is to be obſerved, that all theſe, taken ſeparately, may be made by ſome means or other to take Root; and even the very *Roots* themſelves of a *Tree*, being cut to pieces, and planted after a proper Method, will vegetate and become perfect *Trees.* Dr. *Agricola* of *Ratisbone*, in his *Philoſophical Treatiſe of Agriculture*, preſcribes ſeveral Methods for raiſing *Trees* from their different Parts, by the Aſſiſtance of *Vegetative Mummy*, as he calls it; and I have already tried ſome of his Experiments, which anſwer beyond Expectation; the Account of which may be ſeen in my Preface to the *Engliſh* Tranſlation of his Book. He has four or five ſeveral ſorts of *Vegetable Wax* or *Mummy*, that he makes uſe of for propagating all ſorts of *Trees:* His Method is to dip both Ends of his Cuttings, whether of *Roots* or *Branches*, in one or other of theſe Preparations, and by that Means the Juices contain'd in each Cutting are preſerv'd and nouriſh'd till they are diſpoſed for ſtriking Root, and then the *Mummy* cracks and gives way to the tender *Fibres.* I am of Opinion, was this Way to be further conſider'd, and ſome Improvements added to that Gentleman's Method, we ſhould not only be ſure of making the Cuttings of every kind of *Plant* ſtrike Root, but forward them extremely in their Growth: as for Example: Was I to raiſe *Peach Trees* from Cuttings, I would get together a large Parcel of young Shoots of *Peach Trees*, about Mid-ſummer, and preſs the Juice from them, which I would afterwards put in a Dunghill, or ſome other Heat equal to it, to digeſt for three Weeks or a Month; I would likewiſe burn a large Parcel of *Peach Tree Branches*, and lay by their Aſhes for three or four Months, or more, till they became almoſt like Earth it ſelf; of theſe two Ingredients I would make a Paſte to encloſe the bottom part of my *Peach* Cuttings, ſealing the Top of each Cutting firſt with common Pitch, or ſome ſuch like Matter, and then ſet them in the Ground, and keep them well watered; I ſuppoſe, if Cuttings, ordered after this manner, ſtrike Root, they cannot fail of a vigorous Growth, as the Paſte they are encloſed in contains every thing agreeable to the Nature of the *Plant* it encloſes; and ſo the Cuttings of every ſort of *Tree* may be order'd after the ſame manner.

Could we by this, or Dr. *Agricola*'s way, be certain of the Growth of the Cuttings we plant, we ſhould be ſure of having ſuch a Collection of *Fruit* as we moſt deſire; for the *Branches* or *Twigs* may be cut when the *Fruit* is ripe upon the *Trees.* This leads me to conſider the Uſe of *Soap*, which I was inform'd ſome time ago has an extraordinary Effect on the Vegetation of *Trees*, by anointing the *Roots* with it.

I was told by a curious Lover of *Plants*, that laſt Year, in *June*, he tranſplanted a *Bay-tree* of an Inch diameter in the *Stem*; but for the more convenient Carriage of it from place to place, he cut down the *Plant*, and left only ſix Inches of the *Stem* remaining; and at the ſame time cleared the Earth from the *Roots*, and anointed them well with common *Soap*; in this State he planted it in a Pot, and watered it every Morning; the Conſequence was, as he ſays, that the *Auguſt* following it had ſhot out three *Branches*, each about two Foot long, out of the hard Wood of the *Stem*. This Vegetation ſeem'd ſo extraordinary to me, that I could not help immediately enquiring into the Nature of *Soap*, and the Ingredients of its Compoſition, which I found to be *Aſhes* of *Vegetables*, *Oils* of *Vegetables* or *Fiſh*, or *Tallow* of other *Animals*; I concluded then that the *Aſhes* and the *Oils* of *Plants* might reaſonably contribute to Vegetation; and the common Cuſtom of manuring Lands in the Weſtern and other Parts of *England* with *Fiſh* of ſeveral kinds, made me judge that their *Oil* muſt contribute to the Growth of *Plants*; and the common Method of laying dead *Animals* to the *Roots* of decaying *Trees*, to invigorate them and reſtore their Health, gave me good Reaſon to approve of the Uſe of *Soap*, which I have this Year anointed ſome Cuttings with, eſpecially of *Vines*, in *July* laſt, which have hitherto preſerved their *Leaves* freſh and green, and are now (in *Auguſt*) beginning to ſhoot.

But beſides the Help which *Soap* may give to the Vegetation of *Plants*, I am apt to believe it will be of great Uſe in the Removal of *Plants* to any great Diſtance; for what chiefly gives the Check to a *Plant* in its Removal, is, that the Air ſhrinks and dries up the Veſſels and *Parenchymous* Parts of the *Root*, ſo that they are not for a long while in a Condition to draw in their *Sap* freely; but I conceive that *Soap* will help this Caſe, if the *Roots* are well anointed with it when they are freſh taken out of the Ground, eſpecially in ſuch *Plants* as are Tap-rooted; and it will be further of uſe in keeping the Air from the *Roots* after the *Plant* is ſet in the Ground, till the Earth is firmly ſettled about them. But as I have yet made but few Experiments in this way, I ſhall leave it to my curious Reader to try ſome ordinary *Plants* with it, before he runs the Hazard of a large Quantity; for whether it will agree alike with all ſorts of *Plants*, I cannot yet determine.

As we have already taken notice of the moſt remarkable Particulars relating to *Plants*, we come now to ſay ſomething of their Degrees of Growth, and their Progreſſion in Weight and Stature, from the Time they were encloſed in the *Seed*, to the Fulneſs of their Perfection. In order to this I ſhall begin with the Weight of an *Acorn*, and compare it with a full grown *Oak*, which it may produce; I ſuppoſe about twelve *Acorns*, freſh from the *Trees*, weigh an Ounce, and an *Oak-tree* in its moſt perfect State, (which is I ſuppoſe at a hundred Years Growth) with its *Roots* and *Branches*, may probably weigh about fifteen Ton; ſo that in a hundred Years a ſingle *Acorn* weighing one twelfth of an Ounce, has encreas'd its Weight 33600 Pound, which is 537600 Ounces, or an Increaſe of Parts of equal Value with its firſt Weight 6451200; ſo that one Year with another, for the Term of an hundred Years, it gain'd 64512 Parts, which is 5376 Ounces; for it would be ridiculous to imagine, as ſome have done, that an *Acorn* that had ſhot vigorouſly the firſt Year, ſo as to be perhaps ſix or eight Inches high, ſhould weigh as much as a Year's Growth when the *Tree* is fifty Years old; or that every Year, during the whole time of its Growth, it gains equal Sums of Weight: no; the Caſe is quite otherwiſe, as we find by Experience: the firſt Year the young *Oak* weighs about three times as much as the *Acorn*, and the ſecond Year about three times as much as the *Tree* of one Year, and the third Year three times as much as the ſecond, and ſo on in that Mathematical Progreſſion, during the chiefeſt Time of its Growth; not to reckon the Weight or Number of the *Acorns*, which it might reaſonably bear, from about its thirtieth Year to the hundredth Year of its Age, which I conceive cannot be leſs than a hundred Buſhels, which may probably contain in Number 384000 *Acorns*; (for reckoning ſixty Glands to the Pint, which is 3840 to the Buſhel, in a hundred Buſhels there will be the aforeſaid Number;) and if we ſuppoſe them to weigh after the rate of twelve to the Ounce, the whole amount of Weight will be 32000 Ounces, or 2000 Pound: But I have been as moderate in this Computation of the *Acorns*, as I have been before in the Weight of the whole Body of the *Tree*, with its *Roots* and *Branches*, which I have only reckon'd fifteen Ton. I once remember four Sacks of *Acorns* were gather'd from one *Tree*, which amounted to ſixteen Buſhels; and I believe then one may reckon five Buſhels to be the Produce of a good *Tree*, one Year with another, which, for the Space of a hundred Years, amount to five hundred Buſhels, weighing (according to the foregoing Account) ten thouſand Pound, and are in Number 1920000; ſo that if we allow the Weight of the *Leaves* and *Husks* of the *Acorns*, which the ſame *Tree* produced in a hundred Years, to be equal to the Weight of the *Glands*, then that *Tree* has drawn Nouriſhment from the Earth, Water, and Air, in that Period of Time, 524000 Pound Weight, which is a wonderful Increaſe.

In Annual *Plants*, ſuch as the *Cucurbit* or *Gourd* kind, the proportion of Weight in the full grown *Plant* compared with the Weight of the *Seed*, is much the ſame with that in the *Oak*; and the progreſſive Growth of the *Plant* I ſuppoſe to be much like that of the *Oak*, in proportion to the Length of its Life. In the *Gourd* kind we may reckon a *Seed* to weigh about a thirty-ſecond part of an Ounce, which *Seed* coming to explain it ſelf into a *Plant* of full Perfection, will ſpread its *Vine* in ſix Months to ſuch a prodigious Length, that I have meaſured from the extream Point of one *Branch* to the Extremity of another above thirty Foot, at which time there were growing on it five large *Fruit*, weighing about twenty Pound a-piece one with the other, and as many ſmall ones as might probably weigh thirty Pound; the *Leaves*, *Stalks*, and *Roots*, I ſuppoſe, weigh'd about forty Pound; ſo that the whole had gain'd in ſix Months near an hundred and ſeventy Pound Weight, which is 87039 thirty-ſecond parts of an Ounce more than the Weight of the *Seed*. The *Fruit* of the largeſt kind of *Gourd* is of an Egg-like Figure, ſometimes two Foot in length, and the Diameter of its Breadth a Foot; and this vaſt Fruit is not longer than forty Days coming to its full Growth; now ſuppoſing it but twenty Inches long, and ten Inches thick, it then grows half an Inch in length, and a quarter of an Inch in breadth, one Day with another.

The *Leaves* of the ſame *Plant*, when they are full grown, meaſure about ten Inches over; theſe, from their State in the *Bud*, till they are fully explain'd, require about ſeven Days; ſo that in the Progreſs of their Growth they are expanded about an Inch and half one Day with another. Now when *Vegetables* grow with this ſudden Encreaſe, I ſee no reaſon why we may not obſerve their Motion with a good *Microſcope*; for every one knows (who has been converſant with *Microſcopes*) that we have ſome Glaſſes which will magnify a ſimple Point, ſuch as is not bigger than a Grain of Sand, ſo as to make it three Inches over, or ſhew a Diameter of as much; then ſuppoſing an Inch and half is the Produce of twenty four Hours, and allowing that an Inch in length is equal to fifty Points, then in twenty four Hours the *Leaf* grows ſeventy five of theſe Points; and if we allow every one of thoſe Points to meaſure three Inches by the *Microſcope*, the Produce of a Night and Day is eighteen Foot nine Inches; ſo that if we were to fix a *Microſcope* over one of theſe *Leaves*, when the Sun ſhines upon it, I do not doubt but we might obſerve the Circulation of the *Sap* in the *Leaf*, and have the Satisfaction of ſeeing the *Plant* grow, and its Parts move, much quicker than the Minute Hand of a Clock, and without Pauſes or Reſts in its Motion.

As the Growth of *Plants* is thus eaſy to be diſcerned, and the Circulation of their Juices and the Mode of their Generating is now pretty generally received, ſome unskilful People have alſo thought that ſome of them had a Share of Senſation, as the *humble* and *ſenſitive Plants*, the *Wild* or *Spurting Cucumber*, the *Seed-Pods* of *Female Balſoms*, with others of the like Nature; but this is far from Reaſon, when we conſider that the Fruit of the *Wild Cucumber* never flies from its *Vine* till its Veſſels are over-repleat with Juices, which is the ſame caſe with the *Seed-Pods* of *Balſoms*, whoſe Parts are ſo full when they are quite ripe, that the *Pod* burſts open upon the leaſt Touch; but the falling down of the *Leaves* of the *humble Plant*, and the cloſing of thoſe of the *ſenſitive*, ſeems either to proceed from the Tenderneſs of the Veſſels, which convey their *Sap* into them, and faſten them to the *Twigs* they grow upon, or elſe that they cannot bear any Cold or uncommon Motion of the Air. For in a warm Day, when the Air is ſerene, theſe *Plants*, if they ſtand abroad, are not affected by it, or will ſcarcely give way, tho they are touch'd with ſome Violence; but if the Weather be cool they are ſeemingly declining, and reſiſt the Touch without any Alteration. On the contrary, when they are kept continually under Glaſſes, and the Sun ſhines upon 'em, they do not only decline if they are touch'd with the Hand, but are ſubject to the ſame Alteration by any extraordinary Preſſure or Motion of the Air made by a Fan or Handkerchief at ſome diſtance from them; and I obſerve that they never appear in a right State of Health, or have their Leaves expanded, from the time of the Sun ſetting till it is riſen.

Thus I think I have remark'd what is moſt neceſſary to be obſerv'd in *Plants*, and may be ſufficient to give us an Idea of their Share of Life and Growth; they have *perfect Form* every one according to its Tribe, and may be as eaſily diſtinguiſh'd from one another, as the various Bodies obſervable in the *Animal* Kingdom.

Explanation of the Figures relating to this Chapter.

PLATE I.

Fig. III. *The* Echinomelocactus, *or* Melon Thiſtle, *growing in* Nevis, *St.* Chriſtophers, *and others of the* Caribbee Iſlands, *commonly call'd in thoſe Parts* Turks-head *or* Popes-head.

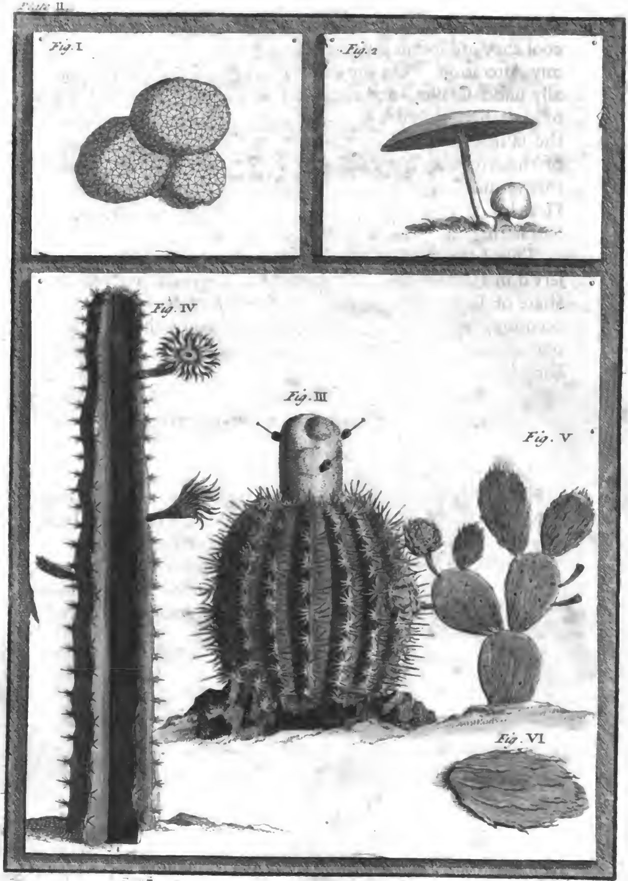
Fig. IV. *The* Upright Torch Thiſtle, *growing wild in* Jamaica, *and other Parts in the* Weſt Indies, *near the ſame Latitude.*

Fig. V. *The* Opuntia *or* Indian Fig-tree, *growing in* Carolina, *and about* Florida.

Fig. VI. *A* Shoot *of the foregoing* Plant *ſhewing its* Leaves.

CHAP.

Plate II.



J. Cole Sculp

CHAP. IV.

Of IMMOVEABLE SHELL-FISH, *and of ſuch as have* LOCAL MOTION; *with Variety of Obſervations upon the reſt of the* FISH-KIND *in Salt and Freſh Waters.*

HAVING taken notice in the former Chapter of ſuch *Plants* as are eſteem'd the moſt *Perfect*, and made mention of the moſt remarkable Particulars relating to their State of Life and Manner of Growth, I come in the next place to treat of thoſe Bodies, which, like *Plants*, want *Local Motion*, but have ſuch a Share of Animal Life as to afford them the Power of Senſation.

Of theſe there are the *Oyſter*, the *Muſcle*, the *Cockle*, the *Barnicle*, &c. which are never capable of removing themſelves from their firſt Station, as far as I can yet learn, notwithſtanding we find of them in and about ſome Shores or Rocks, where they had not been obſerv'd before; but this happens from the *Spawn* of them, which flits upon the Waters, and is carry'd from place to place by the Winds or Tides.

It is remark'd by ſome curious Obſervers of Nature, that ſuch *Shell-Fiſh* as are *immoveable* are *Androginous*; that is, each reſpectively poſſeſſes the *Male* and *Female* Parts of Generation, ſo as to be capable of impregnating it ſelf without the help of another of the ſame Kind; which is the ſame caſe with that which I have mention'd to be natural to *Plants*, which are each of them confin'd to their ſeveral Stations, without the Power of ſeeking at any Diſtance one of a contrary Sex; for which reaſon we may judge that the neceſſary Parts, for propagating of their reſpective Kinds, were thus diſpoſed by Nature.

The *Oyſter* has its Station under ſuch a Depth of Waters, as ſeldom or never to be left uncover'd by them; but the *Muſcle* has generally its Situation in ſuch Places upon the Shore, or Rocks, as by the Fall of the Tides they become expoſed to the open Air; and commonly are found in Beds of large Extent, ſometimes covering near an Acre of Ground, as we may find in ſeveral Places on our *Engliſh* Coaſts: The *Cockle* is always bedded in the Sand upon thoſe Shores that are uncover'd at low Tides, and are ſeemingly fed like *Earth-Worms*, which draw their Nouriſhment only from the Earth or Sand which paſſes through their Bodies; but *Muſcles* and the *Oyſter* we often find will feed upon Sea-weeds when they can come at them; tho' I am of Opinion that their moſt ordinary Food is Mud and the Waſh of the Sea. About three Miles from *Colcheſter* there are little Pits near the River which receive the Tides at High-water, in which they place Baskets of *Oyſters* newly brought from the Sea, letting them remain about fifteen Days or three Weeks, to purge themſelves from their natural Food, and grow green by feeding upon a ſort of *Crow-Silk*, which is in great plenty in thoſe Pits, and then they are reckon'd in a right State for Barrelling up for the Markets, and are allow'd to be much better reliſh'd than any other *Oyſters* found in our *Britiſh* Seas, tho' there are much larger about *Tenby* and *Milford-Haven*. In ſome Parts of the *Eaſt Indies* there are *Oyſters* of that prodigious Size, that a ſingle *Shell* will weigh above an hundred Weight; as we may be farther inform'd by the Reverend Mr. *Pocock*, one of the Chaplains to the Royal Hoſpital at *Greenwhich*, which curious Gentleman has one of them in his Cabinet of Rarities. What we may obſerve more particularly in this Strain of *Shell-Fiſh*, is firſt, that they have no bony Subſtance within their fleſhy Parts; nor do they enjoy the Benefit of Sight, Hearing or Smelling, that I can yet diſcover; neither indeed do I think the neceſſary *Organs* for thoſe Senſes can reaſonably be ſought for in ſuch Bodies as have a fix'd State of Life; the Senſes of Feeling and Taſting being ſufficient for the Maintenance and Support of them. Theſe enjoy a more perfect Share of Life than *Vegetables*, which have only a degree of Life, without any Senſe that we can yet find out. Again, as the Bodies of theſe *Shell-Fiſh*, of themſelves, would perhaps be ſubject to the voracious Appetites of the *Fiſh* of Prey, Nature has wiſely given them Coverings or Caſes of ſo hard a Subſtance as to ſecure them from that Danger; theſe *Shells* have a kind of Vegetative Growth, and have alſo Veſſels of Communication with the Animal they contain; ſo that it ſeems as if the Juices of the one were neceſſary for the Support of the other; which Caſe is well worth the Conſideration of the Curious, as it is partly the ſame in the *Folium Ambulans*, or *Walking Leaf*, which I ſhall treat of at large in the Chapter of *Inſects*.

There are yet many other kinds of *Immoveable Animals* of the Waters, which I might have mention'd in this place; but at preſent, as my Intention is only to offer this as an Introduction to Natural Hiſtory, I ſhall content my ſelf with giving but a few Inſtances of ſuch Things obſervable in Nature's Works, as may tend to explain to us what Affinity the ſeveral created Bodies have one to another, both with regard to their Frame, and their Power of Growth and Motion: And for the better Information of my Reader, ſhall chiefly draw my Inferences from ſuch Subjects as may be come at with the greateſt Eaſe.

The next I ſhall take notice of is the *Scallop* and *Pectunculæ*, which laſt have a perpendicular Motion in the Water, raiſing themſelves from the Bottom in a right Line to the Surface, by flapping their *Shells* with a very quick Motion; and I ſuppoſe the *Scallop*, which ſeems only to be a larger kind of them, has likewiſe the ſame Mode of Motion, which is worthy our Enquiry.

While I am writing this, I have fortunately met with ſome very curious Obſervations of Mr. *Lewenhook*'s, relating to *Muſcles*, in the *Philoſophical Tranſactions*, N° 336, and eſpecially tending to prove them *Androginous*. That learned Gentleman firſt obſerves that *Muſcles* lay their Eggs in Strings, regularly placed one by another upon the Out-ſide of their *Shells*, and that this *Spawn* or *Eggs* continually encreaſe in Strength till they become perfect *Muſcles*, at which time part of their *Egg-ſhells* is diſcoverable upon the outward covering of the *Fiſh*, till that Coat is harden'd or changed into a firm *Shell*.

The next Obſervation was made *November* 18, upon the *Ovarium*, or *Egg-Neſt:* at that Seaſon our Author diſcover'd ſome of their *Eggs* were placed on the Outſide of the *Shells*, while others were yet lodg'd in the *Ovaries*; theſe unborn *Muſcles* had their ſharp Ends faſten'd to the String or Veſſels by which they receive their Nouriſhment. Some Days afterwards he obſerv'd twenty five other *Muſcles* that had not yet placed their *Eggs* upon their *Shells*; from theſe he took a great Number of *Eggs*, which he examined with the *Microſcope*, and found ſome of them ſo ſmall, that he could but juſt obſerve the Figure of them; from others he took ſome that were larger, of a browniſh Colour, mix'd with little Specks; in theſe *Eggs* he diſcover'd ſome of the Parts of the little *Fiſh*, but the ſmaller *Eggs* were tranſparent. In fine, having examin'd a great Number of *Muſcles*, and found the *Ovaria* or *Egg-Neſts* in them all, he concludes, that every *Muſcle* brings forth young ones, laying them not only upon their own *Shells*, but upon thoſe of others; ſo that ſometimes a *Muſcle* is quite cover'd over with *Eggs*. He tells us, that it is his Judgment, after ſeveral Obſervations, that moſt of the *Shell-Fiſh* bring forth their Young without the help of *Males*; each particular *Fiſh* impregnating it ſelf; for that in all thoſe *Muſcles* which he had obſerv'd, he found in the ſmalleſt Particles of their Beards, by the help of *Microſcopes*, that in each Part (which was not the hundredth part ſo big as a common Grain of Sand) there was a vaſt Number of Motions, which remain'd for ſome time after it was taken off from the Body of the *Muſcle*. In theſe Parts he has ſeveral times obſerved *Animalcules* ſwimming; and the ſmall Parts that lay round about were put into ſuch a Motion, that he ſays one may be apt alſo to take them for *Animalcula*; and this gives me reaſon to believe that the *Beard* of the *Muſcle* may perhaps do the Office of the *Male* Part. But this is only Conjecture, and deſerves further to be conſidered.

As to the Food of *Muſcles*, he gives us room to ſuggeſt that it is the fineſt Sandy Parts, and ſome kind of Sea-weed; for he has been as accurate in the Deſcription of the Stomach, as he has been in his Enquiry after thoſe Parts which are appointed for Generation.

We are in the next place to treat of ſuch *Shell-Fiſh* as have *Local Motion*, ſuch as *Lobſters*, *Crabs*, *Star-Fiſh*, &c.

The Habitation of the *Lobſter* is in Holes among the Rocks, where the Sea never leaves them; they have a Power of moving forwards with great Nimbleneſs, either by ſwimming in the Water by the Aſſiſtance of their eight ſmaller Legs, placed four on each ſide, or the Flapping of their Tail, or the Finns lodged under it; theſe *Finns* are edg'd with a kind of Fringe, the better to hold for ſome time their *Spawn*, which is not much unlike *Cole* or *Cabbage Seed*, but chain'd together. Its Motion at the Bottom of the Sea, or upon the Rocks, is aſſiſted by its larger *Claws*, wherein they have ſo much Strength as to reſiſt a Force equal to ſixty Pound Weight; and by means of *Muſcles* in thoſe *Claws* are capable of pinching any thing they can lay hold of with that Strength, that it requires a conſiderable Force to make them quit their Hold; and, as I am inform'd by ſome *Lobſter* Fiſhers, will rather loſe their *Claw* than part with what they have laid hold of: which brings to my Mind what is related of them in the *Memoirs of the Royal Academy of* Paris, *for the Year* 1711, where it is reported, that if one of the larger *Claws* is broken off, and the *Lobſter* ſtill remains in the Sea, it will grow again, or be renewed; which is the Reaſon, perhaps, that we ſeldom find the large *Claws* of the ſame *Lobſter* both of one Bigneſs. If this be true, we may ſuppoſe that the State of *Lobſters* is partly *Vegetable*, partly *Animal*; for *Vegetables* have a Power of renewing their *Boughs* or *Branches* when they are broken or cut off; but no *Animal* that I know of has the Power of renewing a loſt Limb.

To aſſiſt them in catching their Prey, they have two Eyes, and two jointed *Antenæ*, which reach a conſiderable Length before their Bodies, and in which I ſuppoſe there is contained their moſt ſubtile Senſe of Feeling, even ſo as to give them notice by the trembling of the Waters of the Approach of their Enemies, which are out of the Reach of their Eye-ſight, or perhaps to feel out their Food lying at the Bottom of the Sea, which the Situation of their Eyes cannot allow them to diſcern. For the better Marceration of their Food before it enters the Stomach, their Mouths are guarded by four or five Pair of toothed Jaws, each of which has a Power of acting by it ſelf.

I have not yet had Opportunity of ſatisfying my ſelf, whether there are *Male* and *Female Lobſters*, or whether they act in Generation as *Snails* do; that is, if each reſpective *Lobſter*, in the time of Coupling, performs the *Male* and *Female* Act at the ſame time: for in all the *Lobſters* I have opened in *June* and *July*, I find either the *Spawn* is excluded from the Body, and lodged among the *Finns* under the Tail; or elſe I have obſerved a *Spawn*-like Body (which I ſuppoſe to be the *Ovaria*) running through the Fleſh of the *Lobſter*, from a place near the Stomach to the *Orifice* under the *Tail-Finns*. But this Matter I ſhall treat of more at large, when I have had Opportunity of examining it with more Exactneſs

The Natural Hiſtorians have reckoned near thirty ſeveral ſorts of *Lobſters*, all of which are cloathed with *Shells*; and by what I can learn, there are not fewer Kinds of *Crabs*, ſome of them very poiſonous: The larger ſorts of them are commonly found among the Rocks, and, like *Lobſters*, are never uncovered by the Waters; but the ſmaller Kinds are often found upon the Shores at Low Water. I do not hitherto find that any of this Race have the Power of Swimming, or have any Parts analogous to *Finns*.

The *Crab* which I ſhall chiefly take notice of is that ſort commonly found upon our *Engliſh* Coaſt: it is like the *Lobſter*, with regard to its number of Legs and large Claws, whoſe Texture and Parts are nearly the ſame with thoſe of the *Lobſters*; their Body is placed in the Center of their Legs, like that of the *Spider*, but their Motion is Latitudinal or Oblike, contrary to that of the *Lobſter*, which is Direct: This Side-Motion of the *Crab*, I ſuppoſe, happens for want of that jointed Tail to guide it in its Motion, which ſerves partly as a Rudder to guide the *Lobſter* forward. The Eyes of the *Crab* are more prominent from the Body than thoſe of *Lobſters*, and are ſo ſituated, that they can turn them to any Point which they are prompted to move to; for which reaſon I ſuppoſe they are wanting of thoſe *Antenæ*, or *Feelers*, which we obſerve in *Lobſters*; but ſome remark that their Side-Movement is directed by their right Legs, which they ſay are always larger than thoſe on the left ſide. I ſuppoſe the manner of their Generation is ſomewhat like that in *Lobſters*, although they want thoſe *Finns* under the Tail for the Preſervation of the *Spawn*. For I have obſerved in the ſmaller Kind of *Crab*, which I ſuppoſe is in moſt Reſpects analogous to the larger ſort, that the *Eggs* are preſerved in a Knot cloſely link'd together immediately under the Apron, after they are excluded from the Body of the Mother; and the Time of their Spawning is the ſame with that of *Lobſters*.

The *Star-Fiſh* is another *Genus* of *moveable Shell-Fiſh*, tho' its Motion is trifling in compariſon with the former; and of theſe there are ſeveral Kinds, tho' I have ſeen but three ſorts, *viz.* the *Stella Marina Major*, the *Stella Marina Minor*, and the *Stella Marina Arboreſcens:* The Motion of the firſt two is performed by bending their jointed Rays backwards and forwards; but the latter I ſuppoſe muſt be much quicker, if it can make uſe of all its Ramifications, which are ſome thouſands in number. The largeſt of this Kind that I have ſeen is now in the *Muſeum* of the Royal Society in *Crane-Court*, *Fleetſtreet.* The Mouths of all this Kind are in the Center of their Bodies; and I do not find any *Orifice* for the Diſcharge of Excrement, no more than for the Service of Generation. So odd a Creature as this is well worth the Contemplation of ſuch curious Perſons as live near the Sea, where every Day they have Subjects enow to employ their Curioſity, and improve their Underſtanding.

I now come to treat of ſuch other *Shell-Fiſh* as move from place to place, by means of an undulating Motion of their fleſhy Parts out of the *Shell*, after the manner of *Snails:* Of theſe there are ſeveral Kinds, ſome of which can ſwim or creep at their Pleaſure; and others only creep upon the Sands or Rocks. The *Perwinkles* or *Water-Snails*, whether in the Sea or in the Rivers, have the ſame Mode of Motion; we may obſerve them ſwimming on the Surface of the Waters, with their whole Body and Shell reverſed in the Water; ſo that they ſeem to take hold of the Air, and to receive that Reſiſtance from it, which common Snails do from the Earth, or other ſolid Bodies which they creep upon. They have a Power of contracting their Bodies ſo as to encloſe them in their *Shells*, and at their Pleaſure to relax their Parts, and explain or expand them to ſuch a degree, as to fill up twice the Space of the *Shell.* The Fleſh of theſe Creatures is *Viſcous*, and of a porous Texture, by which means they have a Power of adding continually to the Growth of their *Shells*, or re-inſtating any broken Part of them; for the *Viſcous* Matter contained in their Bodies iſſues out in great Abundance to any fractured Part of the *Shell*, and ſoon hardens and joins it ſelf with it. So likewiſe when the Bodies of theſe Creatures grow too big for their *Shells*,

Shells, a Supply of the ſame Juice ſerves to enlarge their Coverings. I ſuppoſe their Generation is much the ſame with that of *Land-Snails*, which ſee in the Chapter of *Snails*, *Earth-Worms*, &c.

The Chief of this Claſs is the *Nautilus*, *Purpura*, *Strombus*, *Murex*, *Buccinus*, *Trochus*, *Concha*, &c. the Beauty of whoſe *Shells*, with the ſurpriſing Variety in their Structure, is as remarkable as the Diverſity of Feathering in Birds, or the various Colouring and Spotting of their Eggs. The great Extent of ſeveral of theſe *Shells* is ſurpriſing, ſome of them weighing near ten Pounds a-piece, without the *Animals* in them. But whoever would ſatisfy their Curioſity in theſe Matters, may have recourſe to the excellent Cabinets of Sir *Hans Sloane*, Baronet; the *Muſeum* of the Royal Society; Mr. *Vincent* at *Harlem*; Dr. *Ruyſh* and Mr. *Albertus Seba* at *Amſterdam*; where they may behold with Admiration the Beauties collected by thoſe learned Gentlemen. But that we may learn likewiſe ſome Account of the Creatures which inhabit theſe teſtaceous Bodies, let me once more recommend the Obſervance of them to thoſe Gentlemen who have the Pleaſure of living near the Sea.

I come now to treat of ſuch *Fiſh* as are Inhabitants of the Salt and Freſh-Waters, that are framed for ſwimming only, and are of ſuch a Compoſure and Texture of Parts, as to breath only an Element as denſe as Water; for the Air to thoſe Creatures is too fine and rarified for them to ſubſiſt in; ſuch as is the Caſe of ſome *Animals*, which are taken up upon high Mountains; for there the Air is ſo much thinner than the uſual Air of their Breath in their natural Station of Life, that it does not contain nouriſhing Particles enough for their Subſiſtance; and has the ſame Effect upon their Bodies as they would find in the Receiver of the Air-Pump, if the more heavy Parts of the Air were drawn out; ſo likewiſe the *Animals* of the Land cannot inhabit the Waters without ſuffocating, no more than the Inhabitants of the Waters can live upon the Land, or in the ſeveral Stations of the Air.

As the *Fiſh* I am now treating of have their Motion and Paſſage from place to place by ſwimming only, it would be to tax Nature with an Indiſcretion to expect any other Parts about them, but what are neceſſary for ſuch a Life and Motion. We plainly diſcover, by many Proofs, that the Water is to them of no more Uſe than Air is to Mankind. Every *Fiſh*, according to its reſpective Tribe, has a Food natural to it, as Land *Animals* have, and without that the Waters are not ſufficient to maintain them.

The Food of *Fiſhes* is either *Plants* or *Herbs* of the Waters, *Inſects*, or other *Fiſh*; 'tis for this Reaſon that they paſs from place to place at certain Seaſons in ſearch of their proper Food. I am informed that even *Whales* go in Troops from the moſt Northern Parts, as far as the Coaſt of *Guinea*, and other Places near the Line, where the Sea is full of Weed, at a certain Seaſon of the Year, and there Couple as *Animals* do, and then in due time return to their Northern Station. The *Whale* is *Viviperous*, and ſuckles her Young, which, I am told, never exceed two in number. Some few Years ſince ſeveral hundred young *Whales* were driven on Shore upon the *Iriſh* Coaſt; and of late ſeveral *Whales* have been taken far South in the Weſtern Ocean, altho' it has been for a long time practiſed to fiſh for them only in the North Seas, where they were ſuppoſed only to reſide.

Mackarel, *Herrings*, and many other Kinds of *Fiſh*, have their Seaſons of coming upon our Coaſts, as well to ſeek their proper Food then in the Chanel, and in our Rivers, as to lay their *Spawn*; and I have not heard that any of theſe Paſſing *Fiſh* have been found in our Seas but at the common Seaſons. It is likewiſe to be obſerv'd, that the *Fiſh* of Paſſage ſwim always in Shoals, and are as punctual to the Times of their coming and going, as the Temper of the Seaſon will permit; ſometimes a ſtrong Wind or cold Weather will keep them back fifteen Days later than their uſual time, and, on the contrary, I have known them come into the Chanel and our Rivers a Fortnight ſooner than they uſed to do, when the Weather has been warm, or the Wind ſet to drive them in: But it is no wonder that their Seaſon of Paſſage depends ſo much upon the Temper of the Air, ſeeing every thing which is proper for their Food is equally depending upon the Weather. The Sea or River-weeds muſt have a certain Temperature of Air to bring them forward; the *Inſects* of the Waters, &c. depend alſo upon the ſame Cauſe for their Hatching; and if our Paſſage *Fiſh* are *Fiſh* of Prey, the *Fiſh* they prey upon will not run before them, if they cannot meet with neceſſary Food.

As to the Time of Running or Paſſing of each particular Kind of *Fiſh*, it muſt not be expected that I ſhould at preſent give an exact Account of them; my Obſervations have not been ſufficient to remark the Seaſons when the ſeveral ſorts of *Fiſh* come into our Rivers, nor have I had Converſation enough as yet with the Sea to give ſo ample an Account as I hope to do hereafter.

If we may believe the curious Obſervers of *Fiſh*, they have two Modes of Generation; the *Squameous* or *Scaley* Kind of them lay their *Eggs* or *Spawn* in ſhallow Water, and the *Milter* or *Male* covers it with a prolifick Juice as ſoon as it is *excluded* from the Body of the *Female*; and when the Waters by means of the Weather become of a certain Temperature, the *Spawn* hatches at once into little *Fiſh*, which for a certain Seaſon ſwim and feed together in Shoals, not caring to mingle themſelves with the *Spawn* or young *Fry* of others, till they are capable of ſhifting for themſelves. 'Tis remarkable, that the ſmaller they are they delight in the ſhallower Waters, and as they gradually encreaſe in Bigneſs make towards the Deep.

The *Cetaceous* Kind for the moſt part are ſaid to couple; and in ſeveral Kinds of them we may plainly diſcover the *Male* and *Female* Parts of Generation. Some of them are *Oviperous*, and others *Viviperous*.

The Number of *Spawn* laid by ſome *Fiſh* is almoſt incredible: The *Roe* of the *Cod-Fiſh*, for Example, in the Space of a *Cube* of one fourth of an Inch contains two hundred and fifty *Eggs*; and according to that Proportion the whole muſt contain about a Million. The great Mr. *Lewenhook* tells us, that in the Space of a ſmall Sand of the *Male Seed* of the *Cod-Fiſh* there are above ten thouſand *Animalcula*. Now ſuppoſing that every *Egg* or *Spawn* of a ſingle *Cod-Fiſh* ſhould come to Perfection, and that in five Years time every one of thoſe *Fiſh* ſhould be capable of producing others, ſuppoſing only half of them *Females*, the Encreaſe of them would then be five hundred thouſand Millions; and five Years afterward, by the ſame Reckoning, there would be an Encreaſe of about a thouſand Miriads of Miriads; which Encreaſe, in the Space of ten Years, from one ſingle *Fiſh*, would give us room to ſuppoſe, that in one thouſand Years, at that rate, the *Cod* only ſo propagated would fill up more Space than the whole World contains. But we are not to imagine that this vaſt Number of *Spawn* or *Eggs* can all of them be prolifick, nor is it without the Hazard of being devoured by other *Fiſh*, or of being deſtroyed by other Accidents: If only a fortieth part of that which is laid annually in the Sea comes to good, the Waters would hardly be able to contain its Produce. Nor are the *Fiſh* of the Rivers and Lakes leſs prolifick, conſidering their Proportion. A *Carp* does not ſpawn leſs than twenty thouſand, and perhaps a *Tench* half as many; and I believe we may lay it down as a general Rule, that the more Enemies a *Fiſh* has to its ſelf and its Encreaſe, ſo Nature has taken Care to provide it with ſuch a Capacity of encreaſing or propagating its Species, that there is a due Allowance to make good all Loſſes that may happen.

It is my Opinion, that moſt Kinds of *Fiſh* are partly dictated by Nature to ſhift their Place about *Spawning* time, as well for the Preſervation of their young ones as for the ſake of their Food. And it is obſervable, that the Paſſing *Fiſh*, after they have ſpawn'd, find out ſome other Station, perhaps becauſe they would avoid thoſe *Fiſh* which would prey upon them, if they were to ſtay in the ſame Place.

The Forms and Texture of the Parts in *Fiſh* are as various as what we find in the *Vegetable* Kingdom: every one is provided with neceſſary Parts to defend it ſelf againſt, or to avoid, its Enemies. The *Flying-Fiſh* has Finns of ſo great a Length, as to do the Office of Wings in the Air for a certain time, till they become dry, as well as ſerve them for Conveyance from place to place in the Waters: by this Means they avoid the *Dolphins*, which purſue them to prey upon them. One of theſe ſort I have delineated in Plate VIII, Fig. I, which was drawn from that in the Royal Society. The *Sword-Fiſh* and *Saw-Fiſh* I have alſo taken the Figures of, (from thoſe at Mr. *Salter*'s Coffee-houſe at *Chelſea*) to ſhew what Weapons Nature has provided them with for their Defence; which makes me ſuppoſe that they are not without Enemies that prey upon them, notwithſtanding they ſometimes meaſure ſix Foot in length. And, to ſet aſide the fabulous Account of the *Siren* or *Mermaid*, I have likewiſe in the ſame Plate added the Figure of the true *Mermaid-Fiſh*, as it is now preſerv'd in the ſame Collection of Rarities.

The *Orbis Echinatus*, and *Lanthorn-Fiſh*, are alſo naturally guarded with *Spines* which cover their whole Bodies, ſo that no kind of *Fiſh*, be they ever ſo voraceous, dare attempt them. Nor is the *Perch* without its *Spines* in the back Finn, which it can raiſe up at Pleaſure for its Defence when its Enemy draws near.

But it is not only by theſe natural Arms or Weapons that *Fiſh* preſerve themſelves, or their *Spawn*, from the *Fiſh* of Prey; they have likewiſe a natural Cunning, which furniſhes them with Contrivance to make themſelves Neſts or Caſes of Shelter for themſelves and their *Spawn*; an Inſtance of which I have lately been agreeably furniſh'd with by the learned ------- *Hall*, Eſq;

Serjeant at Arms, who made me a Preſent of a *Tickleback*'s Neſt, which he obſerv'd the Structure of from near the Time of its Beginning, till it was brought to the Perfection it is in the Figure: It is compoſed of little *Fibres* of *Roots*, ſo placed together, as to leave an hollow *Tube* in the Middle, which I ſuppoſe was rather compoſed to lay the *Spawn* in, than for a Lodgment for the *Fiſh* it ſelf; for the *Tickleback* has a ſharp Thorn in its back Finn, which I ſuppoſe is ſufficient to defend it from *Fiſh* of Prey; but as they always live in the ſhalloweſt Water, ſo their *Spawn* would be too much expos'd to the *Swallows*, or other Birds, which delight to be near the Waters, was it not to be defended from them by ſome ſuch like Covering. About the End of *May*, or Beginning of *June*, is the Time when theſe little Builders are at work, as I am inform'd by the above-mention'd curious Gentleman. And ſince we have this Inſtance of the Contrivance of one kind of *Fiſh* for its Preſervation, or the Preſervation of its Young againſt Enemies, we may as reaſonably conjecture that other ſorts of *Fiſh* have their reſpective Methods of building Neſts or Shelters for their Security, which is no more than all Birds do, tho' after different Manners. And indeed we do not find any living Creature whatever that has not ſome Senſe or other which guides it to the Study of its Preſervation: Even the *Cados-Worms* have each reſpectively, according to its Tribe, a Mode of making its Caſe or Lodgment after a particular manner, to defend themſelves from the *Fiſh* which are very voracious of them. One Kind makes its Covering of the Points of *Ruſhes*, another of ſmall *Shells*, and a third of fallen *Leaves*, which by Means of a *Viſcous* Matter they glue and cement together in ſuch a manner that it is hard to ſeparate them. The three Kinds which I here mention, were engraved from the Originals in the curious Cabinet of Mr. *Dandridge* in *Moreſields*, where there are many other ſorts of them among his numerous Collection of *Engliſh Inſects*.

Fiſh ſeem to enjoy the Power of *Senſation* as perfectly as any other *Animal*. Their Sight cannot be diſputed, and even ſeems to exceed the Sight of many *Animals* for its Quickneſs; and I ſuppoſe their Taſting and Smelling are not leſs perfect; for we find moſt Kinds of *Fiſh* will take one Bait rather than another, altho' they are compoſed of ſeveral Ingredients, and have no regular Form; which ſeems to determine that either their Taſte or Smelling is more pleaſantly affected by one thing than another. But indeed I do not find that the curious Obſervers of *Fiſh* are of Opinion that they want any Senſe but that of Hearing; and even they do not determine whether that Senſe is abſolutely wanting or not: But if I may be allow'd to judge from an Experiment I have made upon *Carps* in ſeveral Places, I believe it will be allow'd that they enjoy that Senſe as well as the reſt.

At *Rotterdam*, in a Garden belonging to Mr. *Eden*, a very curious Gentleman, I had the Pleaſure of ſeeing ſome *Carps* fed, which he kept in a Mote of a conſiderable Extent; the Occaſion of my ſeeing theſe Creatures, was chiefly to ſatisfy me that they were capable of hearing. The Gentleman having fill'd his Pocket with *Spinach Seed*, conducted me to the Side of the Mote, where we ſtood mute for ſome time, the better to convince me that the *Fiſh* would not come to us till he call'd them. At length being deſirous to ſee the Event, he call'd in his uſual way, and immediately the *Fiſh* gather'd together from all Parts of the Mote in ſuch Numbers, that there was hardly room for them to lie by one another, and then he flung ſome *Spinach Seed* among them, which they devour'd very greedily. This alone would have ſatisfied me that *Fiſh* had the Senſe of Hearing; but upon relating the Story to ſome curious Gentlemen, I was told, that at Sir *William Bowyer*'s, near *Uxbridge*, there is a Pond of *Pikes* or *Jacks*, which they call together at Pleaſure, and I think is more ſurpriſing than what I have mention'd of the *Carps*; for the *Pike* is held to be a more wild, untameable *Fiſh* than the *Carp*; and as it is a *Fiſh* of Prey, it has been thought impoſſible to civilize it, or make it any way familiar with Mankind. There are indeed many Inſtances of *Carps*, and *Tench*, which will come of their own accord, at certain times, to ſome particular part of a Pond to be fed; but I ſuppoſe they have been trained up from their firſt Year to feed at one Corner of the Pond rather than another; that is, when one part of a Pond has been continually ſupplied with ſuch Ingredients as are proper Food for them, either by means of an accidental Drain, or deſignedly.

I have this Year taken a large Parcel of young *Fiſh*, juſt after hatching from the *Spawn*, and have kept them near three Months in Earthen Pans, with a little Earth at the Bottom; the *Fiſh* are of ſeveral Kinds, and do not only thrive, but are now ſo familiar, that upon my Approach they come in Shoals to the ſide of the Pans to be fed: The firſt thing I fed them with was Wheat Flower ſcatter'd here and there upon the Water, for the *Fiſh* were then ſo ſmall that they could not ſwallow any thing larger than a Grain of Flower; at the ſame time I gave them freſh Water from the *Thames*, which I ſuppoſe was not without ſome nouriſhing Parts in it; but now they are large enough to feed upon ſmall *Inſects*, and little Bits of Paſte made of Flower and Water, which they readily catch at as ſoon as I fling it in. Towards the Winter I deſign to enlarge their Bounds, and I ſuppoſe then, with a little Care, I may keep them to their familiar way of Feeding, where and when I pleaſe: For I find it is with *Fiſh*, as it is with *Birds* or other *Animals*, that the beſt way to civilize them, is to have the Management of them when they are very young, and by that Means they may be brought to do any thing within the Bounds of their Comprehenſion, or that is agreeable to the Structure of their Parts; and their Memory is ſo conſtant, that after this early Impreſſion they hardly ever forget it. But the Docility of *Fiſh*, I believe, does not exceed what I have here related.

To conſider the Parts of *Fiſh* more particularly, we may obſerve that every Kind of *Fiſh* has its Jaws framed for the taking and macerating of its particular ſort of Food: Such as feed upon *Weeds* and *Inſects* have ſeldom any Teeth; but ſuch as prey upon other *Fiſh* have one, two, or more Rows of Teeth, for the better grinding their Food. The Gills of the *Cod-Fiſh* are guarded with Tooth-like Bones, which I ſuppoſe are no leſs contributing to Maceration than Teeth themſelves. The *Finns* are in proportion to the Bodies of the *Fiſh* they relate to, and ſerve as Oars to row them from place to place, and raiſe them to any height, or ſink them to any depth in the Waters, while the finny part of the Tail ſerves them as a Rudder to guide their Courſe. And for the more eaſy bending of their Bodies, their Back-bone conſiſts of very ſhort *Vertebræ*, ſo join'd together, that their Tail may be eaſily bent up to the Head; and that ſuch bending of their Bodies may meet with no Obſtruction from their outward Coat, the *Scales* are ſo regularly placed in Rows one over another, and cover'd with ſuch a *viſcous* Matter, that they give way without difficulty to the Motion of the *Fiſh*'s Body, and ſlide with Facility through the Waters.

The *Scales* of *Fiſhes* are as remarkably different, as the *Fiſhes* are various which have them for their Covering; and many of them, being examin'd with *Microſcopes*, are of very ſurpriſing Figures, ſome of them not unlike the *Shells* of *Pectunculæ*. All *Fiſh* indeed have not *Scales*, but ſuch *Skins* as are of a Leather-like Subſtance, and *viſcous* on the Outſide; and I think this laſt Kind are moſt of them, if not all, *Viviperous*, bringing forth their Young perfectly form'd. I am aſſured by many Fiſhermen, that they frequently take at the *Buoy of the Nore*, about *Chriſtmas*, a *Fiſh* which they call a *Coney-Fiſh*, ſomewhat like an *Eel*; and that at that Seaſon they are full of young ones, alive, and very nimble in their Motion; and I am of Opinion, at that Seaſon of the Year, which is the time when *Eels bed*, or lay themſelves up in the Mud, we might diſcover the manner of their Breeding.

The Share of Life which ſome *Fiſh* poſſeſs is very remarkable, and is ſomewhat like that we obſerve in ſome *Inſects:* The *Eel*, for Example, being cut to pieces, maintains Life and Motion for ſeveral Hours, as if every *Muſcle* of its Body enjoy'd a diſtinct Soul or Spring of Motion whereby it lives, till the Part wanting a Supply of Nouriſhment is forced to ſubmit. And this is nearly the ſame in *Plants*, which have in every diſtinct Part of them (abſtracted from the Body) a Power of vegetating and producing every particular Part which may be found in a full grown *Plant* of the ſame Kind they were taken from. A *Carp* is likewiſe poſſeſs'd of a very ſubtle kind of Life, and will move vigorouſly ſeveral Hours after the Inteſtines are taken out of its Body; and I have even ſeen one of its Finns move a conſiderable time after it has been over the Fire in a Stew-Pan; but I have not obſerv'd whether the Heart will beat after it is taken out of the Body, as that of an *Eel* will do, with regular Motion for above an Hour. I ſuppoſe that *Fiſh* are generally long-liv'd, and that *Carps* eſpecially will live above a hundred Years: For in ſome large Pools or Fleets (as they call them) which have not been fiſh'd or look'd after in the Memory of Man, there have been *Carp* taken near three Foot in length; and it is very rare to find a dead *Fiſh* in any Pond, unleſs it has been kill'd by ſome Wound or other Accident.

Next to an *Eel* I believe a *Carp* will live the longeſt of any *Fiſh* without Water; for it is common to tranſport them alive in Paniers with Wheat-Straw forty or fifty Miles; and I once had ſome *Carp* that lived near thirty Hours without Water. I cannot help obſerving in this place what I have often heard of the *Herring*, that it dies as ſoon as it is taken out of the Sea, becauſe I can affirm the contrary from my own Knowledge. About two Years ſince, being in Company with my worthy Friend Mr. *Tho. Balle*, and ſome other Gentlemen of *Devonſhire*, at the

Drawing of a Sein or Net, among other *Sea Fiſh* we caught a large *Herring*, which lived in my Pocket near half an Hour; this gave me a Thought of contriving a Method of preſerving ſome of the ſmaller Kinds of *Sea Fiſh* alive, which would be very agreeable to the Sight, and as pleaſant to the Palate, if we were to dreſs them freſh taken out of the Water, when we could have no immediate Opportunity of getting them new out of the Sea.

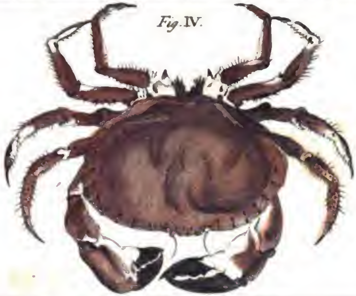
Where we are near enough to the Sea, and upon a Level with it, we might make little Store-Ponds to be fed by the Tides, which would ſerve to maintain ſome Kinds of *Sea Fiſh*, eſpecially if the Water in thoſe Ponds was always kept in Motion; for we find by Experience the Motion of the Water is as material as the Saltneſs of it to preſerve Life in *Fiſh* of the Salt Water Race. Witneſs the Method the Fiſh-Women in *Holland* take to keep *Plaice* and ſome other *Fiſh* alive in Tubs, by moving the Water continually with Paddles, till all their *Fiſh* is diſpoſed of; for if they were to let the Water ſtand quiet for a few Minutes the *Fiſh* would die: Therefore to keep the Water continually moving in the Salt Ponds which I here propoſe, we might place a couple of Wheels with Trenchers, like thoſe in common Water-Mills, to be turn'd by the Flux and Reflux of the Waters, and by their Motion produce a continued Agitation in the Water of the Ponds; or elſe where we can have the Benefit of a River to turn a Wheel continually, we might make a Baſon to hold a ſmall Quantity of Water, which may be ſalted agreeable to Sea Water, by adding to it one fortieth part of common Salt, *i. e.* a Pint or Pound of Salt to thirty nine Pints or Pounds of Water. Sir *Hans Sloane* kept a *Turtle* or *Sea Tortoiſe* a long time in Water prepared after the ſame manner.

But to return to my Remarks upon the Degree of Life in *Fiſh*, we may obſerve that the *Flounder* and many others will live a long time after their Bowels and more noble Parts are taken out of their Bodies, which is more than we can obſerve in any of the *Land Animals* or *Birds*; for in them, as ſoon as the Heart is taken from its original Station, a Struggle or two finiſhes their Life; which ſhews plainly that Circulation of Juices in different Creatures is not always promoted by the ſame Cauſe, or perform'd in the ſame Manner. For no Creature can live any longer than their Juices circulate; and every one allows, that in *Land Animals* the Heart is the immediate Cauſe of Circulation.

It may perhaps be expected that I ſhould be more particular in this Account of *Fiſh*, and that I ſhould deſcribe the ſeveral Kinds of them; but that is not my Deſign in this Work; my Buſineſs at preſent is to give only a general Account of thoſe Remarkables in the Creation, which I know my ſelf to be fact, and here and there drop ſuch Hints as may lead the Curious to farther Obſervations, in order for them to frame right Ideas of the Degrees of Life and Motion in the ſeveral Particulars of the Creation. We may indeed obſerve that there are *Whales* of twenty one Foot long, and *Fiſh* of all Proportions from that Length to an Inch only: and that in ſome Lakes there are Kinds of *Fiſh* which are not perhaps found elſewhere: That the enormous Bulk of the *Whale* exceeds all other Creatures upon Earth; and the Smallneſs of the *Tickleback* is inferiour to any Kind of *Bird* or *Quadrupede* yet diſcover'd. But was I to relate every thing I have heard concerning *Fiſh*, or other living Creatures, I might ſwell this to a large Volume, and make my ſelf accountable to the World for a thouſand Falſities. Indeed what Informations I have from ſome particular Gentlemen, who give me leave to back their Relations with their Names, I gladly receive, and publiſh to the World as ſo many Inſtances of their generous Spirits and Curioſity. I confeſs that I have not read much upon this Head, but avoided thoſe Books which treat of the Subject of this Work, as much as poſſible, leſt I ſhould be too much biaſs'd by the

Plate III.

Fig. IV.



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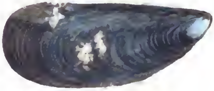

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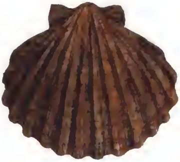

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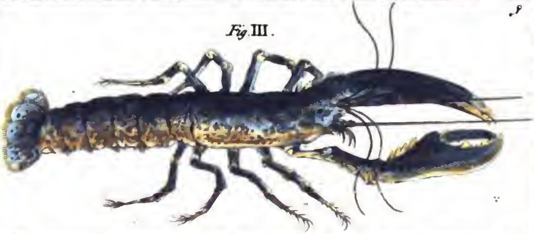

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Plate IV

Fig IV.

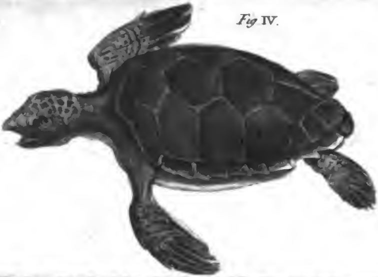


Fig II.

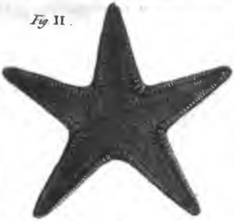
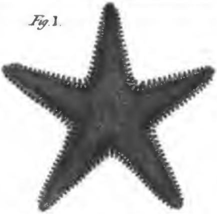


Fig. I.



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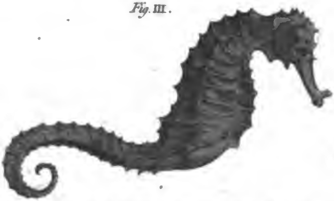
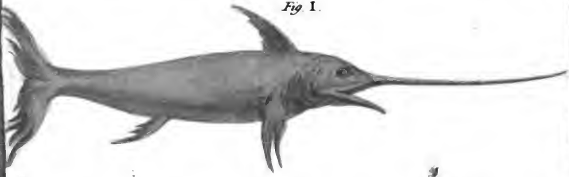


J. Cole sculp.

Plate V

Fig. I.



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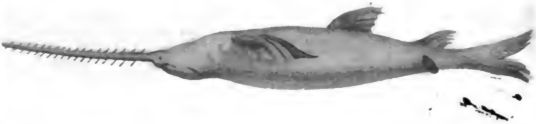

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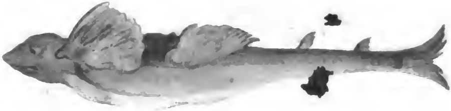


Cole Sculp.

the Thoughts of Authors, who themſelves might have been impoſed upon. The great *Willoughby* indeed has given us undoubted Truths in his *Treatiſes* of *Birds* and *Fiſh*, which are generally allow'd the beſt Inſtructors for ſuch as are diſpoſed to ſtuddy the Structure and Nature of thoſe Creatures, to which I refer my Reader. I ſhall now proceed to ſpeak of thoſe *Quadrupedes* which are the neareſt related to the *Scaley* Tribe.

Explanation of the Figures relating to this Chapter.

PLATE III.

Fig. I. *The* Muſcle.
Fig. II. *The* Scallop, *whoſe Motion is perpendicular.*
Fig. III. *The* Lobſter *lying in its natural Poſition.*
Fig. IV. *The large* Sea-Crab.

PLATE IV.

Fig. I. *The Upper-ſide of the* Star-Fiſh *moſt common upon our* Engliſh *Coaſt.*

Fig. II. *The Under-ſide of the ſame* Fiſh.

Fig. III. *The* Shell-Fiſh *call'd the* Sea-Horſe, *found upon the Coaſt of* Italy; *taken from the Royal Society.*

Fig. IV. *The* Turtle, *or* Sea-Tortoiſe, *cloathed in* Shell, *the firſt of the finny Race; drawn from Mr.* Salter's *Collection at the Coffee-Houſe at* Chelſea.

PLATE V.

Fig. I. *The* S[illegible]rd-Fiſh.
Fig. II. *The* Saw-Fiſh.
Fig. III. *The* Mermaid, *or* Syren.
N.B. *All this* [illegible]*te taken from Mr.* Salter's *Coffee-Houſe at* Chelſea.

PLATE

PLATE VI.

Fig. I. *The* Orbis Echinatus; *from Mr.* Salter's.

Fig. II. *The* Whiting.

Fig. III. *The* Silver Eel, *whereby the Difference between the* Smooth Fiſh *and the* Squameous *Kinds may be obſerved.*

PLATE VII.

Fig. I. *The* Roach, *which may ſerve to give a general Idea of the* Squameous *or* Scaley Fiſh.

Fig. II. *The* Flounder, *or firſt of the flat* Fiſh. *In this Kind it is remarkable that the* Males *have their Mouths on the right Sides of their Bodies, and the* Females *on the left.*

Fig. III. *The* Thornback, *ſhewing its upper and lower Sides.*

PLATE VIII.

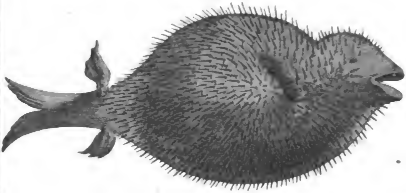
Fig. I. *The* Flying-Fiſh; *from the Royal Society.*

Fig. II. *The Neſt of the* Tickleback *obſerved by Mr.* Hall.

Fig. III. *The Neſts or Caſes of four ſeveral Kinds of* Cados-Worms *found in the Waters.*

Plate VI

Fig. I.



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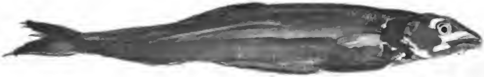

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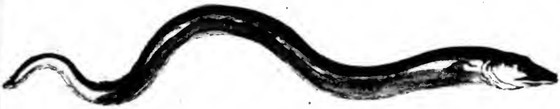
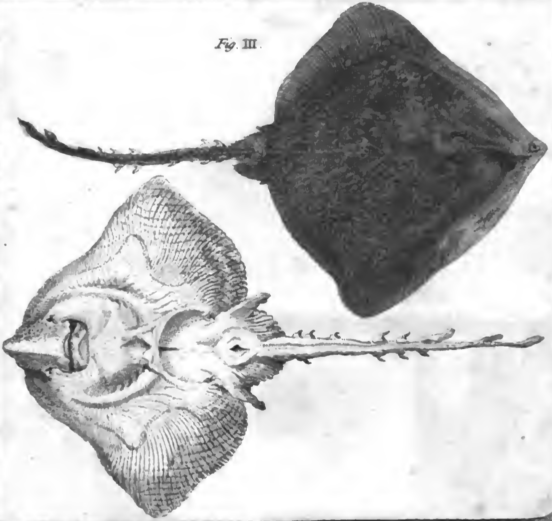


J. Cole sculp.

Fig. III.



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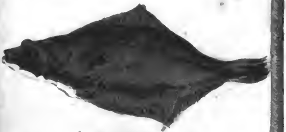


Fig. I.

J. Cole Sculp.

Plate VII

Fig. I

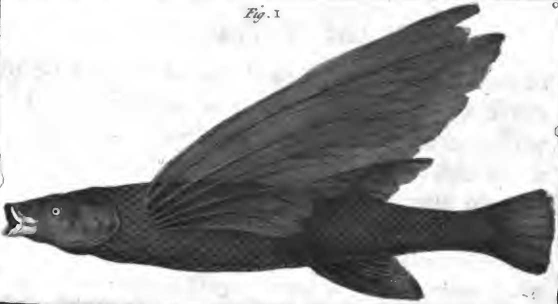


Fig. II

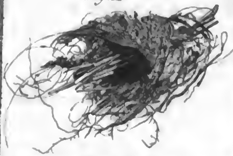


Fig. III

J. Cole Sculp.

CHAP. V. and VI.

Of SERPENTS, *the* CROCODILE, LIZARD, CAMELION, *and others of the Scaley Tribe, which are Amphibious, and Inhabitants of the Land; and of* FLYING LIZARDS, &c. *which ſeem to be the immediate Paſſage between the Fiſh and Bird kind.*

AS the foregoing Chapter treats of ſuch Creatures of the Waters as are generally cloathed in *Scales*, I can no where ſo properly introduce the Race of *Serpents*, *Snakes*, &c. as in this place: theſe ſeem to poſſeſs many Particulars found in *Fiſh*; as the manner of placing their *Scales*; their *Eel*-like Motion; but above all, their Degree of Life. As I have taken notice above of the extraordinary Motion of every *Muſcle* of an *Eel*, and ſome other *Fiſh*, after they are cut to pieces; ſo ſuch Motion is no leſs remarkable in ſome *Snakes* and *Serpents*, after their Bodies are divided into ſeveral Parts. And the Food likewiſe of our common *Snakes* is much the ſame with that of our River *Eels*, they both feeding upon *Frogs*, *Toads*, and ſuch like.

Of this Race I do not find above three ſorts in *England*, *viz.* the *Snake*, the *Viper*, and the *Slough-Worm*. The firſt is an harmleſs Creature, as far as I can obſerve, tho' many believe the contrary: For this Year I have had ſeveral alive, which have been familiar about the Houſe, without doing any hurt; tho' ſome have taken them into their Boſom. I have heard that what Poiſon they have lies about their Tongue, but that they loſe it the firſt Dart they make at any thing they are angry with, and can never recover it again till they get to Water: But if it was ſo, I believe People would hardly venture to take them up careleſly in the Fields, as I have ſeen ſeveral times. The *Viper* indeed has a deadly Poiſon lodged in little Bladders about the Root of its Fangs; but his whole Body beſides is a Dainty, eaten very frequently. The learned Dr. *Tyſon* tells us in his Account of the Diſſection of a *Rattle-Snake*, *Phil. Tranſ.* N° 144, that the *Male Viper* has four *Penes*, agreeing in moſt Particulars with the *Penes* of the *Male Rattle-Snake*, which are likewiſe four in number, altho' the *Females* of both Kinds have each of them only two *Uteri* for receiving them. He conjectures that two of theſe *Male* Parts enter at one time into one *Uterus*, and ſpread themſelves like the *Pythagorean* Y, that they may the better and more firmly be retained there till they have performed their Duty. He tells us that both the *Rattle-Snake* and the *Viper* are *Viviperous*; but the common *Snakes* we all know are *Oviperous*; their *Eggs* being frequently found in Dunghills.

The ſame Gentleman gives us a long Detail of the ſeveral Parts *External* and *Internal* of the *Rattle-Snake*, which he diſſected at the Repoſitory of the Royal Society in *January* 168⅔, illuſtrated with many extraordinary Obſervations, which I refer my Readers to, as well as the curious Cuts which he has prefix'd to the above Tranſaction. In Plate IX of this Work I have given a Cut of one of thoſe *Rattle-Snakes*, now in the Repoſitory of our Royal Society; and in the ſame Plate I have given likewiſe a Figure of another Kind of *Serpent*, as well to ſhew the different Frame of the Heads of various Kinds of *Serpents*, as to give my Reader the Satisfaction of obſerving the ſurprizing Variety of Colours, and different Methods of their Scaling.

In the Cabinets of the Curious we may find vaſt Varieties of the *Serpent* Kind; but I think none of them can be more remarkable than that preſented to the Royal Society the laſt Year by Dr. *Mead*, which is above five and twenty Foot long, and is now preſerved in their *Muſeum:* The Body in the thickeſt part, altho'

altho' it is now dry, meaſures about ten Inches diameter; and I believe is one of the largeſt ſorts produced in the *Eaſt Indies*.

Immediately after this Race follows the *Crocodile*, *Allegator*, *Lizard*, &c. which are covered with *Scales* like the former, placed conveniently in the *Lizard* Kind, for the eaſy bending of their Bodies: The Shape of their Heads is agreeable to the Figure of the Heads in *Snakes*, and they are *Oviperous*; but for the Aſſiſtance of their Motion upon the Land, Nature has added to their Bodies four Branches or Legs a-piece. Their Habitation is partly in the Waters, and partly upon the Land: The firſt agreeing with the *Fiſh* Kind; and the latter, as well as the Legs they are endow'd with, make them Partakers with Land *Animals*.

We have Accounts of *Crocodiles* and *Allegators* of above twenty Foot in length; and I am of Opinion that ſome of theſe Creatures having been formerly in *England*, has given Riſe to the many fabulous Accounts, which have been handed down even to our Times, of *Dragons*; and this I the more readily believe, becauſe the Skeletons of ſome ſuch Creatures, or the Impreſſions of them in Stone, or other *Mineral* Matter, have been dug in ſeveral Parts of this Kingdom; which ſhows plainly that there have been ſuch Creatures in this Iſland.

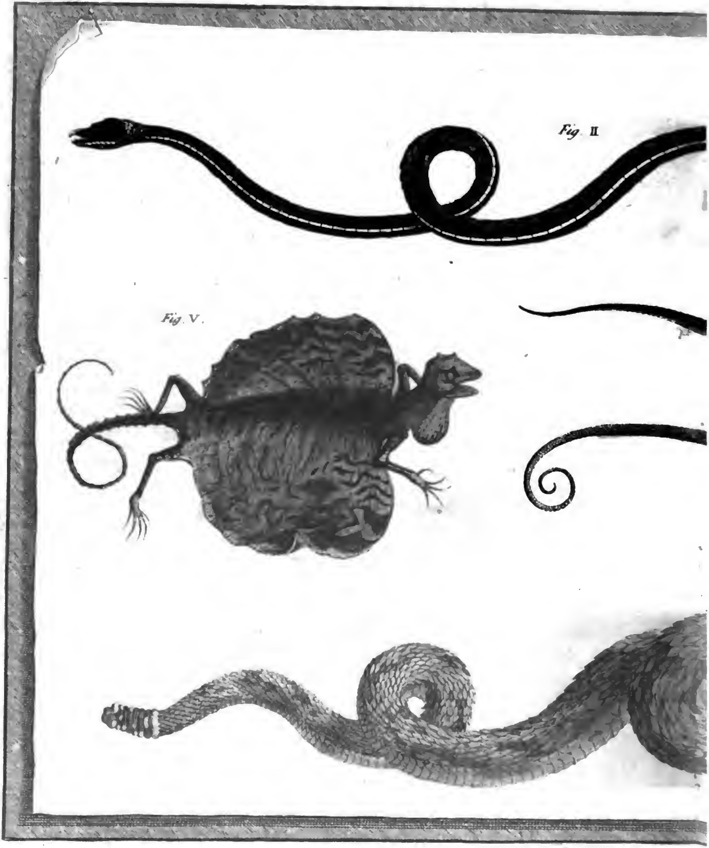
The *Lizard* Kind is very numerous, and I queſtion not but there is as great Variety of them as there is of the *Serpent* Race. Upon *Hamſtead Heath* I have obſerved a ſmall ſort of them of a browniſh Colour, perching upon the *Furze* and *Broom* growing there; and I have heard of a ſmall green ſort likewiſe in *England*, but have not ſeen it

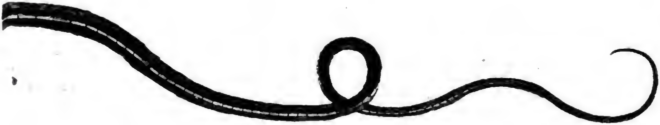
The *Water-Neutes* are almoſt of the ſame Figure, and are ſaid by ſome to be poiſonous; tho' I have handled them very often, without receiving any Injury from them. We have beſides theſe a larger kind, found commonly in moiſt ſhady Places, which are black on their Back, and have yellow ſpeckled Bellies; and theſe likewiſe I do not find have any Venom in them. Theſe two laſt Kinds lay *Eggs* about eight or ten in number, and the *Crocodiles* and *Lizard* Kind are ſaid to do the ſame; and none of theſe, as I can learn, either feed or ſuckle their Young, but leave them to ſhift for themſelves as ſoon as they are hatcht. The Natural Hiſtorians have given us large Accounts of theſe Creatures, which I refer my Reader to for his further Satisfaction.

The *Camelion* is a Creature, whoſe Figure is near enough to thoſe of the foregoing Race, to accompany them in this Chapter; but its Life and Habitation is altogether upon the Land: its Skin is Shagreen'd, like that of the *Dog-Fiſh*, and tranſparent; ſo that ſometimes one may perceive through it different Colours, as its Body happens to be in a different State. This Creature has been reported to live upon the Air only; but thoſe among the Curious, who have kept them alive, tell us, that their chief Food conſiſts of *Flies*, which they catch, by darting out their Tongue with great Quickneſs. All the *Animals* which I have yet mention'd in this Chapter are ſaid to ſleep, or are laid up, in the Winter.

The Creature which ſeems to be next ally'd to the foregoing Race, is the *Wing'd* or *Flying Lizard*, whoſe Shape and Turn of Body, in many Reſpects, is like that of the ſmall *Italian brown Lizard*, or that ſort found upon *Hamſtead Heath*: the *Wing'd* Part of it is in Subſtance much like the *Wing* of a *Batt*, but the Head is different from that of the *Lizard* Race; and the *Pouch* under the Throat I am told contains a poiſonous Matter. This kind of *Flying Lizard*, which I have delineated in Plate IX. Fig. V. was preſented me by Dr. *Ruyſh* of *Amſterdam*, who received it with other Rarities from the *Eaſt Indies*: And the ſame Kind may be obſerv'd in the Cabinets of Sir *Hans Sloane*, Mr. *Vincent* of *Harlem*, Dr. *Ruyſh* and Mr. *Seba* of *Amſterdam*.

Plate IX





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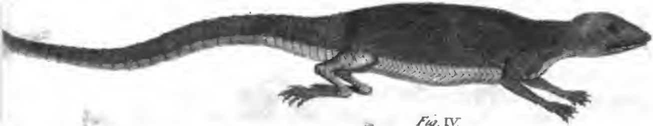


Fig. IV.

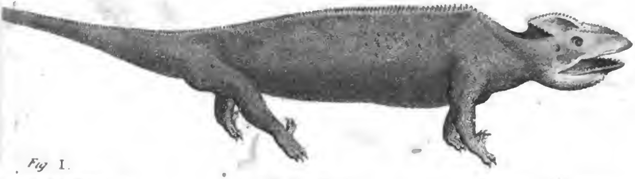
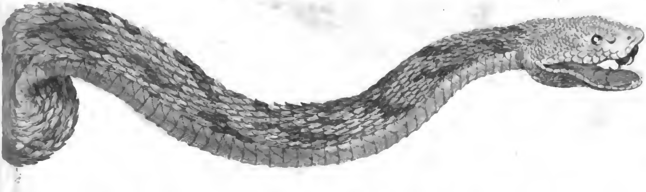


Fig I.



J. Cole sculp.

In the *Weſt Indies* there is another ſort of *Flying Lizard*, different in the Colour and Make of its Wings from the former; and inſtead of a Bag under the Throat, has a thin Film or Skin hanging down, almoſt of the Shape of a *Myrtle Leaf*; this and the other Kind is ſaid to be *Oviperous*; and in the Accounts Dr. *Ruyſh* gave me of them, it appears that they have each of them the Power of Flight, and generally perch upon *Trees*; which leads me naturally to treat of *Birds* in the next Chapter.

Explanation of the Figures relating to this Chapter.

PLATE IX.

Fig. I. *The* Rattle-Snake *from the* Weſt Indies; *taken from one of thoſe preſerv'd in the* Muſeum *of the Royal Society.*

Fig. II. *A* Weſt Indian Serpent; *taken from the Original in the ſame* Muſeum.

Fig. III. *A* Lizard; *from Sir* Hans Sloan's *Cabinet.*

Fig. IV. *The* Camelion; *from the Royal Society.*

Fig. V. *A* Flying Lizard *from* Amboina *in the* Eaſt Indies; *from my own Collection: the ſame is in Sir* Hans Sloan's *Cabinet.*

⁂

CHAP. VII. and VIII.

Of BIRDS *and* FOWLS; *as alſo of the* BATT *(or Fluttermouſe)* FLYING SQUIRRELS, *&c. which ſeem to be the Paſſage between Fowls and Four-footed Beaſts.*

IN this Chapter I ſhall treat of ſuch *Animals* as are cloathed with *Feathers*, and in many Reſpects agree with the laſt mention'd *Animals*, which are, like *Birds*, *Oviperous*, have four Branches to their Bodies, and poſſeſs the Power of Flight. To which we may likewiſe add that remarkable Analogy, which there is between ſome Kinds of *Birds* and the *Animals* mentioned in the preceding Chapter, which lay themſelves up, or ſleep, during the Winter.

The *Birds* which have this kind of Reſt, and are loſt to us, during the Winter Seaſon, are *Swallows*, *Martins*, *Swifts*, *Cuckows*, *Nightingales*, and ſome others; and as the Spring Seaſon is more or leſs temperate, ſo does it influence the waking of theſe *Birds* from their State of Reſt, as it does alſo all *Animals* that ſleep the Winter. The *Cuckow* and *Nightingale* commonly begin to ſing about the firſt Week in *April*, and the *Swallows*, *Martins* and *Swifts* appear about that time; nor is Nature leſs bounteous to all its Off-ſpring, when it rouſes theſe Creatures from their Lethargy. The *Vegetables*, which the Winter-Froſts retrenched of their Beauties, are enliven'd, and diſplay their uſual Ornaments, and become an agreeable Shelter and Habitation for thoſe *Birds* which are re-inſtated in Life. This Temperature of Air equally puts the Juices of all the *Sleepers*, whether *Animals* or *Vegetables*, into Motion; and if ſuch a Temperature of Air happens to reign for any time before the natural Seaſon, it has the ſame Effect upon their Bodies, and rouſes them from their Lethargy. It is remarkable, that this Year (1719) we had no Froſt or Snow of any Continuance in *England*, unleſs in the moſt Inland Parts. The Softneſs of the Weather in *January* and *February* was ſuch as produced the Effect I mention, of waking theſe *Birds* before their Time. In *Lincolnſhire*, and the adjacent Counties lying next the Sea, ſeveral *Cuckows* were ſeen and heard to ſing in the firſt fifteen Days of *February*; ſome Hives of *Bees* ſwarmed about the ſame time; and *Batts* were flying about, as they do commonly in Summer Evenings; but a cold Eaſterly Wind coming, ſoon afterward put them to Reſt again. Theſe *Birds*, which ſleep the Winter, have certain Periods of Time in the Summer, when they are loſt to us. About the middle of *June*, *Nightingales* and *Cuckows* have finiſhed their Song, and are ſeen no more till the following Spring. Indeed, as a Matter of Curioſity, I have known *Nightingales* kept in Cages for two or three Years together; and if they have been ſet in warm Places they have ſung at *Chriſtmas* There is now a Perſon living in *Fetter-lane*, *London*, who is never without them; and at a Coffee-Houſe near his Royal Highneſs the Prince of *Wales's* Court in *Leiceſter-fields*, there is now one of them.

Birds differ from four-footed Beaſts in the manner of their Generation, and bringing forth of their Young: In theſe the *Female* has only one Cluſter of *Eggs*; but we always find two *Ovaries* in every *Female* of the four-footed Race. In *Birds* and *Fowls* the *Egg* is made fecund by the *Male*, before it is excluded from the Body of the *Female*; and every *Egg* in the Body of the *Female* has a Power of Growth, to a certain Magnitude, before it can be diſcharged from the *Hen*, even tho' ſhe has not been in Company with a *Cock*: For I have often ſeen *Birds* that have been kept in Cages lay *Eggs* in *April*, altho' they have not ſo much as ſeen a *Male* of their own Kind; but theſe *Eggs* were not prolifick, altho' the *Hen* has ſet upon 'em above a Month.

In theſe *Winged* Creatures there's the ſame Poſſibility of Coupling between two of different Species, as there is between four-footed Beaſts of different Kinds. It is common for *Cock Pheaſants* to tread the *Hens* of common Poultry; but whether their *Eggs* are prolifick; and if they were, whether the *Chickens* were of a different Make, I know not.

The Covering or Cloathing of *Birds* and *Fowls* muſt next be conſidered. They have growing upon them *Hair*, *Down*, *Feathers*, and *Quills*: the *Hair* is hardly to be diſtinguiſhed but upon the larger ſort; and I think *Down* is only found upon what I call *Fowls*; for *Birds* and *Fowls* are in many things different from one another, *viz.* *Birds* always carry their Meat to their Young; *Fowls* lead their young ones to their Meat. All *Fowls* make their Neſts upon the Ground, whereas on the other hand *Birds* build for the moſt part in *Trees*, *Hedges*, &c.

Every *Fowl*, whether of the Land or Water, has its Body cover'd with *Down*, either during a certain Space after it's hatch'd, or during its whole Life. The *Land Fowls*, ſuch as *common Poultry*, *Partridges*, *Turkies*, *Pheaſants*, and ſuch like, only have this *Down* upon them till their *Feathers* appear. The *Water Fowls*, ſuch as *Swans*, *Geeſe*, *Ducks*, *Widgeons*, *Teal*, &c. have always a *Coat* of *Down* under or beneath their *Feathers*.

The *Feathers* of *Birds* ought alſo to be carefully conſidered, how they vary in Make and Colour, with reſpect to the different Parts of the Body which they grow upon; and this Variety ſeems to proceed from the Difference of the Juices in the ſeveral Parts they cover. All young *Birds* are cloathed in *Feathers* of very different Colours from thoſe they are dreſſed with when full grown; ſo that I ſuppoſe, in the firſt Stage of a *Bird*'s Life, the Juices have not the ſame Powers in any part of the Body, that they poſſeſs in the ſecond or laſt Stage of its Life. And it is likely that the *Hair* and *Wool* of *Quadrupedes* changes Colour as they grow older; for the ſame Reaſon, *Feathers* I ſuppoſe to have a kind of *Vegetable* Life; and I think it is not unlikely that they come from *Seeds:* they are all of them *Annual,* being renew'd yearly; and therefore it is no wonder if want of Nouriſhment, or over-abundant Heat of the *Bird's* Body, alter their Colours; which is no more than we meet with in common *Plants,* which often have the Colour of their *Leaves* and *Flowers* chang'd as the Nature of the Soil directs. An Inſtance of this was in ſome *Roots* of the *Double Blue Hepatica,* that were ſent to Mr. *Harriſon* of *Henley* upon *Thames,* from Mr. *Keys's* Garden in *Tuttle-fields,* whoſe Soil was ſo different from the Ground they were planted in at *Henley,* that when they came to bloſſom there they produced *White Flowers,* and were therefore returned back to their firſt Station, where they retook the *Blue* Colour they had at firſt. And I have obſerved many other *Flowers* which have changed from the ſtronger Colours of *Blues, Reds,* and *Yellows,* to a plain *White,* by altering the Soil.

Every diſtinct Species of *Birds* has to it ſelf a certain Manner of Feathering; yet it is poſſible to produce other Birds from them which ſhall differ in the Colour of their *Feathers.* I believe every Kind of *Bird* may have had one of its Race with *White Feathers,* which happens from the want of Nouriſhment, or ſome ill Quality reſiding in the Juices that feed them, as was ſaid before. I have been told by Perſons of good Reputation, that in King *Charles* the IId's Time there was a *White Crow* in St. *James's* Park. I have very often ſeen *White Sparrows;* and ſome time ſince I caught one of thoſe *Birds,* commonly called a *Robin Red-Breaſt,* with all the *Feathers* from the Throat downward of a clear *White,* and every other *Feather* about him very different from the common *Feathers* of thoſe *Birds.* The laſt Year I was at the taking of one of the *Thruſh* or *Black Bird* Kind, cover'd with *White Feathers:* this Change of *Feather,* from a ſtrong Colour to *White,* is frequent among *Pheaſants* and *common Poultry;* and where this happens, I find that the Coupling

ling of one which is of the natural Colour, with one of the *White* ſort, is the Cauſe that in the Breed or Encreaſe ſome are *Mottled*, others *White*, and rarely any of the natural Colour, eſpecially (as I obſerve) if the *Cock* was *White*. I think we may lay it down as a Maxim, that where-ever *Whiteneſs* is ſeen in the *Feathers* of *Fowls*, *Hairs* of *Beaſts*, and *Leaves* or *Flowers* of *Plants*, it proceeds from Weakneſs, or want of Nouriſhment, in the Bodies they grow upon.

It is worthy our Obſervation, the Contrivance of *Birds* in the Building of their *Neſts*; how every diſtinct Species hath a Method peculiar to it ſelf in preparing its Lodging, not only as to the Curioſity of its Frame, but the Choice of certain Materials of which it is compoſed; and even its Situation is not leſs regarded by them. The Form of a *Martin's Neſt* is wonderful, as well if we conſider how every part of *Clay* or *Mud* is brought in little Particles to make the whole; as alſo the Poſition of thoſe *Neſts* under Shelter of ſome Pent-houſe, or horizontal Covering, to keep them from the Injuries of the Weather. As to the Form of the *Neſt*, 'tis like a Cup pointed at the Bottom, with a ſmall Hole or Notch towards the Brim pointing to the Eaſt to go in at, and the Inſide is lined with *Feathers*, to make it eaſy for their Setting. The *Magpye* is likewiſe as careful to preſerve its Young from the Injuries of the Weather and *Birds* of Prey as the *Martin*; but Nature has given him a different kind of Cunning, his *Neſt* is guarded on all ſides with *Thorns*, and lined with *Mud*, which he ſmooths beyond the Gueſs of any one that has not ſeen it.

The *Neſts* of other *Birds* are every one as remarkable as theſe we have already mentioned. 'Tis I think impoſſible any one can paſs by the Works of theſe little Creatures without admiring the Delicacy of their Compoſition, and Beauty of their Contrivance; and particularly ſome of thoſe *Birds Neſts* which are ſo common in the *Weſt Indies*, which are faſtned to the Ends of tender *Twigs*, and hang upon Strings of about half a Yard in length; by this Means the Birds and their *Eggs* are ſafe from deſtroying *Vermin.*

'Tis obſervable that the *Bills* of ſeveral Kinds of *Birds* are diſpoſed in ſuch manner, that they can imitate an human Voice; and their Memory of ſuch Words or Tunes as have been often repeated to them is not a little ſurpriſing: 'Tis frequent to find ſome Kinds of *Parrots* that will repeat more than a hundred Words, and expreſs every Syllable with that Exactneſs, that many have been deceived by their Voice. *Jays*, *Starlings*, *Magpies*, *Bullfinches*, and the *Robin Red-breaſt*, are often taught to pronounce Words diſtinctly: And there is now at *Chelſea* near the *Ferry*, a *Raven* that ſpeaks ſeveral Words plainly to be underſtood. Among theſe *Birds* which I have mentioned for ſpeaking, we may further obſerve the Tones of their Voices. The *Raven* has a Voice very deep and hoarſe, as a Baſs to the reſt. *Parrots*, *Starlings*, and *Magpies* come nearer the common Tone of Mankind, as it were a Tenor to the former. The *Bullfinch* and *Robin Red-breaſt* ſpeak in a Treble Tone or Pipe. One would think that the Mouths or Organs of Sound in four-footed Beaſts were near enough reſembling the Mouths of Men, to be made pronounce Words: but hitherto we have not found any *Quadrupede* that could be taught to ſpeak; and when I conſider this, I am ſurpriſed to find *Birds* (whoſe Beaks are ſo very different from the Figure or Frame of the Organs of Speech in Mankind) ſhou'd be taught to utter Words ſo diſtinctly as they do. As for the *Speaking Dog*, indeed, which made ſo much Noiſe this Year in *London*, he utter'd ſeveral Words and Sounds; but they were not of himſelf, no more than an Inſtrument of Muſick cou'd produce Variety of Notes without the Help of an Artiſt to play upon it. The Maſter of this *Dog* having ſet him in a convenient Poſture to get the full Management of his Throat and Chaps, made him growl, and moved his Chaps and Throat in that manner with his Hands, that ſome Words he was appointed to ſpeak were plain enough pronounced to be underſtood; and I conceive it is no difficult Matter to bring any *Dog* to ſpeak ſome Words, if we make uſe of the ſame Means: But *Birds* repeat Words diſtinctly without any Aſſiſtance of this kind.

The *Wings* of *Birds* anſwer to the Fore-feet of Beaſts, ſo far as to make up the four Branches of the Body; and in the Motion of *Birds* upon the Ground, aſſiſt them to move forward with greater Swiftneſs, as well as ſerve them for Flight. The *Quills* and larger *Feathers* of the *Wings* are remarkably different from thoſe on the reſt of their Body, and ſeem to bear the ſame Proportion with the other *Feathers*, that *Trees* do to *Plants* of an under Race. The other remarkable Parts of *Birds*, wherein they differ from *Quadrupedes*, are their *Beaks* or *Bills*, which are all of a Horny Subſtance, ſome long and pointed, as in the *Kingfiſher*, *Woodcock*, *Snipe*, &c. others ſharp and ſhort, as in *Nightingales*, *Linnets*, and other *Birds* of piercing Note. Others again have clubbed *Bills*, as the *Bullfinch*, &c. ſome hook'd *Bills*, as *Hawks*, *Owls*, *Parrots*, which give them a hollow Voice; and in moſt *Water Fowl* flat *Bills* ſeem to prevail, as in the *Swan*, *Gooſe*, *Duck*, &c. As the *Beaks* of them are various, ſo do their Notes or Voices all differ juſt in the ſame manner that *Quadrupedes* differ in the Tones of their Voices, by having their Mouths or Organs of Sound of various Makes.

The *Legs* of *Birds* are all of them covered with *Scales*; and as to the number of *Toes*, I think they are generally the ſame, *viz.* three on each *Foot* with a *Heel:* The *Oſtridge* indeed has but two; but theſe are all pointed with *Claws*, the which, as well as the *Scales*, are of different Make and Colour, as the *Fowls* or *Birds* they relate to are different in the other Particulars of their Bodies. But we may take notice likewiſe that Nature was not unmindful of the Uſes of theſe Parts when they were firſt framed. To the *Birds* of Prey ſhe has given *Talons*, for the better taking

king an dmanaging of their Food: And to ſuch *Birds* as are inclinable to perch, ſhe has been no leſs benevolent and careful in the Frame of their *Claws*; ſo likewiſe the *Fowls* both of the Waters and the Land are not unprovided of ſuch Means, as only her own Wiſdom could contrive the Model of for their Swimming and Walking.

The *Tail Feathers* of *Birds* are diſpoſed proportionably to each Kind to aſſiſt in their reſpective Flights, chiefly by helping them to riſe from the Ground, and ſerve as Rudders to guide their Bodies in the Air.

The Movement of *Birds* upon the Ground is of two Kinds. *Crows*, *Larks*, *Water-Wagtails*, and all the *Fowls* of both Land and Water ſet one *Leg* before the other: *Sparrows*, *Goldfinches*, and the greateſt part of the *Bird* Kind jump from place to place. All the *Birds* that have fallen under my Obſervation drink Water; but there are ſome four-footed Beaſts that never drink, as the *Hare*, *Coney*, and ſome others. 'Tis reported that the *Camel* will travel three Weeks without drinking; but ſee more of this in the Chapter of *Quadrupedes*.

The Food of *Birds* is of various Kinds, ſome preying upon *Birds*, others feeding upon *Carrion*, others upon *Fiſh*; but the greateſt part upon *Fruit*, *Grain*, and *Inſects*. The *Eagle*, and all of the *Hawk* Kind, with admirable Artifice take their Prey: And *Ravens*, as if their Smelling was the chief of their Senſes, will follow *Carrion* many Miles; and the *Stork*, *Heron*, and all the *Water Fowls* are endued with no leſs Sagacity and Contrivance in catching of *Fiſh*, which is their proper Food. *Sparrows* and other *Birds* of the lower Claſs, flock together in Corn-Fields and Gardens, where the *Corn*, or other *Grain* or *Fruit* is fit for their eating: Others are no leſs vigilant and watchful to deſtroy *Caterpillers*, and ſuch like *Inſects*, where they are in any plenty. From hence we may reaſonably conjecture, that the Cauſe of *Birds* paſſing from one Country to another, is to meet with their proper Food. For in the ſame Climate or Country it is impoſſible to find a continued Store of *Inſects* or *Grain* from the Beginning to the End of the Year for them to feed upon.

The *Birds* of Paſſage are the *Wood-Cock*, *Quail*, *Wind Thruſh*, *Fieldſare*, *Stork*, and ſome others; though the Seaſon of their Paſſing is different. The *Woodcock*, *Red Wing*, and *Fieldſare*, make theſe Parts their Refuge in the Winter, and are rarely found here after the Froſt is over; tho' I have been informed there have been *Neſts* of young *Woodcocks* taken about *Tunbridge*; and I was once Eye-witneſs of a Brace of theſe *Birds* taken in their *Neſt* about the Middle of *May*; but I ſuppoſe the old ones had been wounded, and could not change their Station. About the Time theſe *Birds* commonly leave us, the *Quails* preſent themſelves; and about the ſame time in *Holland*, and ſome other Places in *Europe*, the *Storks* return to their *Neſts*. Upon this Subject of the Paſſing of the *Stork*, I have lately received a curious Letter, which I ſhall here inſert for the Entertainment of my Reader, as it agrees perfectly with what I obſerv'd of that *Bird* when I was in *Holland*.

SIR,

B*Eing lately in* Holland, *I enquired as much as I could of the People, concerning the Coming and Departure of thoſe* Storks, *which I there ſaw in ſuch great Numbers: The Account the People* (*eſpecially at* Harlem) *gave me was this, That the* Storks *having bred, and the Young flying about with them, at the End of* September, *or thereabouts, as the Heat of the Summer more or leſs continues, theſe* Storks *gather together* (*in the Peoples Opinion, almoſt to a* Bird) *about a great Piece of Marſhy Ground, there called* Harlem Meer; *being all aſſembled, they remain there ſeveral Days Chattering and Snapping with their* Bills, *till the laſt* Birds *are come to them in this Place of their Rendezvous. After this they make no more Noiſe; but in a little time they*

they all riſe ſlowly together, ſoaring up in a great Flock and Body, making in the Air as they ſoar up ſeveral Rounds and Circles, till by degrees this great Flock of Birds, *which at its firſt Riſe almoſt darkens the Air, goes gradually higher and higher, till at laſt they appear to be in a manner but a Point, and ſo diſappear till the next Spring they viſit them again.* I am, *&c.*

The *Eggs* of *Birds* are as remarkably different from one another as the *Birds* themſelves, and ſeem to keep a juſt Proportion with the *Birds* or *Fowls* that laid them. Their Spots and Variegations of ſeveral Colours are as worthy our Remark, as the *Feathering* of their Mother *Fowls*. The Number of *Eggs* laid by each Kind is for the moſt part conſtant: *Birds* eſpecially ſeldom exceed five or ſix in number, unleſs it be the *Tom Tit* and *Wren*, which ſometimes lay about twelve a-piece; but *Fowls* commonly exceed that Number. It is remarkable, that if we take away the *Eggs* of *Fowls*, they will ſtill continue to lay to the Number of thirty or forty *Eggs*; ſo that they ſeem to have a diſcretional Power of ſtopping when they have laid as many as they can ſet upon; or if they ſhould happen to be ſpoiled by any Accident, they have a natural Freedom, whereby they can renew and make good their loſt Clutch of *Eggs*. *Sparrows* and other Birds which are familiar about Houſes, will ſometimes breed three times in a Year; and *Pidgeons*, if they are well fed, will breed eight or nine times in a Year. The Time of Setting is about three Weeks for *Birds* and *common Poultry*; but *Turkeys*, *Pheaſants*, and ſome others do not hatch under a Month. It is poſſible to hatch *Eggs* of all Kinds, without the *Hen* ſetting upon them. I have my ſelf experienced the Hatching of *Chickens*, by means of an artificial Heat, agreeable to that of the *Hen*'s Body.

Thus have I remark'd what is moſt obſervable in the *feathered* Tribe; and that I may proceed gradually from theſe Creatures which have the Power of Flight, to the Race of *Quadrupedes*, or four-footed Beaſts, I am obliged to take notice of the *Batt* or *Fluttermouſe*, and *Flying Squirrels*, which ſeem to be the natural Paſſage between *Birds* and *Beaſts*.

Of the *Batt* or *Fluttermouſe* I have ſeen three Kinds, *viz.* the common ſort frequent in *England*; one ſort about one fourth bigger than the common, with Ears twiſted like *Rams* Horns, about an Inch and half in meaſure; and a third Kind brought to us from the *Weſt Indies*, whoſe Body is as large as a *Rat*, and the Wings being extended meaſure from Point to Point above two Foot. In theſe Creatures there is no remarkable Difference that I can remember, but the Size of their Parts.

Theſe *Animals* partake of the four-footed Kinds in the Make of the Head, which agrees perfectly with thoſe of the *Mouſe* or *Rat* Kind; the Shape of the Trunk of their Bodies likewiſe is much the ſame, and are both cover'd with Hair. Theſe *Animals* are alſo *Viviparous*, bringing forth their young ones perfectly formed (like *Quadrupedes*) and give them Suck.

They partake of the *Bird* Kind in having only two Legs, beſide the Hooks at the Points of their Wings; they have alſo the Power of Flying, and ſleep like *Swallows* in the Winter. I have found many of theſe in old Walls in the Winter, that have been quite void of Motion, and preſſed together ſo cloſe, that they hardly preſerved their natural Figure; and yet theſe, as I was informed by ſeveral Perſons, having been brought to a Fire, revived, and flew about the Room. The Note or Voice of theſe *Animals* is between the Chirping of *Birds* and the Cry of four-footed *Beaſts*. Theſe Creatures have not long Tails like *Animals* with four Feet.

I have not had the good Fortune to meet with a *Flying Squirrel* perfect enough to take a good Figure from; tho' there is one in the *Muſeum* of the Royal Society, which is enough to ſatisfy us that there is ſuch an *Animal*, and ſhew us that it has not only the neceſſary Parts for Flight, but partakes ſo much of the *Quadrupede*,

Plate X

Fig. I

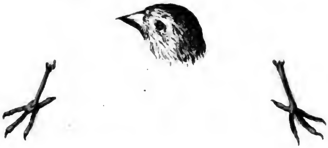


Fig. II

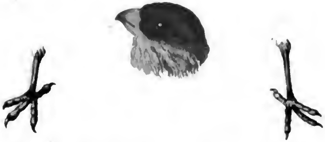


Fig. III

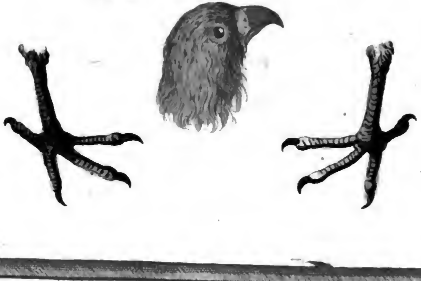


Plate XI

Fig. I

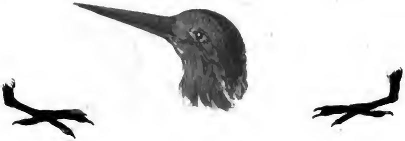


Fig. II

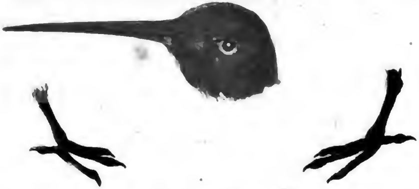
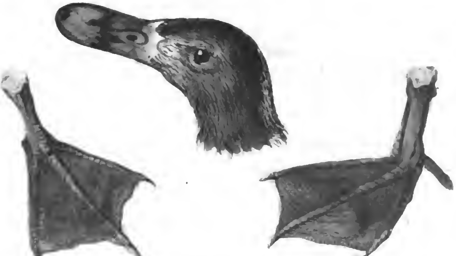


Fig. III



J. Cole Sculp

drupede, as may lead us to the Contemplation of four-footed *Beaſts*, which is the Subject of the next Chapter.

Explanation of the Plates relating to this Chapter.

PLATE X.

Fig. I. *The* Head *and* Legs *of a* Linnet; *the firſt ſhewing the manner of its* Bill *or* Organs *deſigned by Nature for the Utterance of the moſt piercing Note: The ſecond ſhews the manner of its* Legs *and* Claws *diſpoſed for Perching.*

Fig. II. *The* Head *and* Legs *of the* Bullfinch, *whoſe* Beak *is Clubbed, diſpoſed for the Utterance of more hollow Notes.*

Fig. III. *The* Head *and* Legs *of a* Hawk, *wherein we may obſerve how Nature has diſpoſed them for the Catching of its Prey.*

PLATE XI.

Fig. I. *The* Head *and* Legs *of the* Halcion, *or* Kings-fiſher, *which Parts are naturally diſpoſed for Climbing and Catching its Food, which chiefly conſiſts of* Inſects *in the* Bark *of* Trees, *and* Earth-Worms:

Fig. II. *The* Head *and* Legs *of the* Woodcock, *whoſe* Bill *is contrived for ſearching for his Food in the Ground, ſuch as* Earth-Worms, *&c.*

Fig. III. *The* Head *and* Legs *of a* Gooſe, *which may ſerve to give us an Idea of the ſame Parts in moſt Kind of* Water-Fowl.

N. B. *This and the foregoing Plate were drawn from Mr.* Dandridge's *Cabinet in* Moorfields.

PLATE XII.

Fig. I. and II. *The* Bird of Paradiſe *in two Views; taken from the Royal Society.*

Fig. III. *A* Bird of Paradiſe *from* Amboina; *drawn from Dr.* Ruyſh's *Cabinet at* Amſterdam.

PLATE XIII.

Fig. I. *The Back of the common* Batt, *ſhewing wherein it relates to the* Bird *Kind, and what Affinity it has to* Quadrupedes.

Fig. II. *The Fore-part of the ſame* Batt; *from Mr.* Dandridge's *Cabinet.*

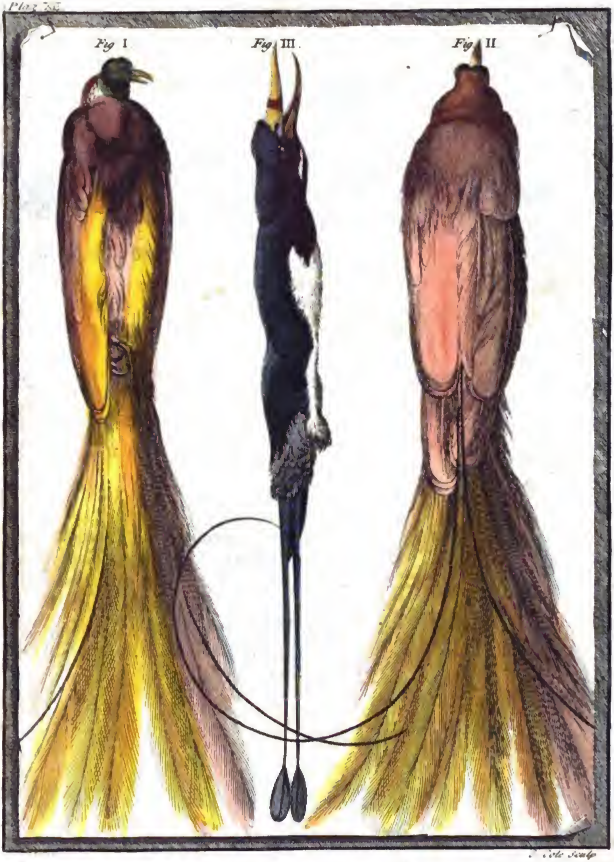
CHAP. IX.

Of QUADRUPEDES, *or ſuch* ANIMALS *of the Viviparous Race, as have four Legs or Branches to their Bodies.*

THE Tribe of *Animals* with four Feet are for the moſt part cloathed with *Hair*; but ſome few only have a *Scaley* Covering, or elſe are cloathed in *Spines*. The general Heads I ſhall range them under are, the *Tallon-footed*, the *Claw-footed*, the *Hoof-footed*, and the *double Hoof* or *Cloven-footed:* And again, thoſe of the *Horned* Race I ſhall diſtinguiſh by the Characters of the *Perennial horn'd*, and the *Annual horn'd Beaſts*.

The largeſt of the four-footed Race is the *Elephant*, and I think there is none ſmaller than the *Mouſe*. The Method of Motion

Plate XL.



Cole Sculp

Plate XIII

Fig. I.

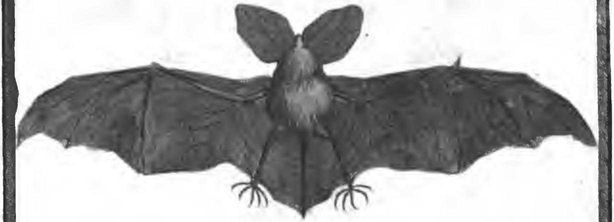
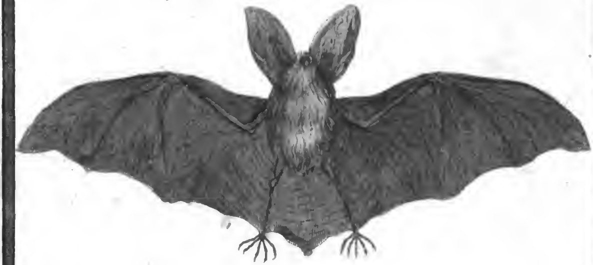


Fig. II



J. Cole Sculp

Motion in all this Tribe is horizontal, and to a few only is given the extraordinary Power of Climbing, by means of their ſharp *Talons*, or by the Frame or Texture of their fore Feet, with which they can lay hold of the *Branches* of *Trees*, or whatever may be helpful to them for their Conveyance. The Walking of theſe Creatures is perform'd by moving the *Off-leg* before and *Near-leg* behind at one time, and following that Motion with the two contrary *Legs*; but in their Running they lift up at once their two *fore Legs*, and in the next Motion follow them with their *hind Legs*; ſo that the latter ſucceed the former in every Point of Ground, and in every Motion forwards of their Body; by this laſt Method of Motion a good *Horſe* will paſs over four Miles in length in about ſeven Minutes, which I believe is as much as any of the Race of *Quadrupedes* can do; but is not to compare with what is reported of the Flight of ſome *Birds*. If we believe the Accounts given us of the *Carrier Pidgeon*, which we are told will fly twenty Miles in fifteen Minutes, and may eaſily be try'd; at that rate ſuch a *Bird* flies eighty Miles an Hour, which, in a natural Day, or four and twenty Hours, would amount to 1920 Miles; which continued Flight, during that Length of Time, I believe is in the Capacity of a *Bird* to perform; conſidering the Paſſage of ſome *Birds*, which, if they go to any part of this World when they leave us, it muſt be at leaſt two thouſand Miles, *i. e.* either into *Tartary*, or ſome part of *Africa*; for I do not find that they are ever obſerv'd in *Europe* when they have left this Country. And I am of Opinion, that few *Birds* can fly much longer than four and twenty Hours without reſting, or at moſt two Days without eating: But we are ſure that Animals of the four-footed Kind cannot even maintain the height of their Swiftneſs a quarter of an Hour: So that it appears that *Birds* have a far greater Share of Strength and Spirit than *Quadrupedes*.

There are five ſorts of *Hair* obſervable in the Cloathing of *Quadrupedes*, *viz.* the ſhort *Hair* upon the *Hides* of *Horſes*, *Aſſes*, and *Kine*; the long *Hair* in the *Mains* and *Tails* of *Horſes*; the *Wool* of *Sheep*; the *Briſtles* of *Hogs*; and the *Hairs* in the *Beards* of *Cats*, *Tygers*, &c. Theſe have every one of them a kind of *Vegetative* Growth, and are renew'd Yearly, unleſs the Creature they grow upon is diſtemper'd. I ſuppoſe them to be of the Nature of *Bulbous-rooted Plants*, which when the *Leaves* of them decay, a new framed *Root* from the ſame *Plant* ſupplies their Loſs with freſh *Leaves* the next Seaſon. In the *Hedghog* the *Spines* or *Thorns* which cover its Body are *analogous* to the *Hairs* upon the *Skin* of other *Quadrupedes*; but I ſuppoſe may remain for many Years, whereas the others are *Annual*; and ſo likewiſe I imagine the *Quills* of the *Porcupine* to fill the place of *Hairs* in other *Beaſts*, tho' they are of a much harder Subſtance; and all theſe Coverings, as they proceed from the Bodies of different *Quadrupedes*, commonly vary in their Colours, but are never ſo beautiful as the *Feathers* of *Birds*. Among *Beaſts* we never obſerve any *Hairs* of a *Scarlet* Colour, nor is *Blue* or *Green* natural to them, and even *Yellow* is very ſparingly given to this Tribe; while, on the other hand, *Birds* are adorn'd with *Feathers* of all Colours. Their Note, and Beauty of their Plumage, lead the *Ear* and the *Eye* into the greateſt Admiration; but when we conſider them farther, they are but Toys in compariſon of *Quadrupedes*, which, tho' they are not thus gayly attir'd, do that Service to the World, that it is worth while even for MEN to attend upon them, and ſerve them in ſome Reſpects, and even bear the Expence of their Living.

The *Lion*, *Panther*, *Tiger*, *Leopard*, and *Cats* of all Kinds, have ſharp *Talons*, ſomewhat reſembling thoſe in the *Eagle* and *Hawk* Kind; and for the better preſerving them from wearing or blunting their Points, Nature has provided Caſes for them in the *Paws* of thoſe Creatures they relate to. What I call the

Claw-footed, are *Dogs* of all Kinds, whoſe *Claws* are of a *Horny* Subſtance, ſomewhat like the former, but are not guarded. *Hoofs* of *Horſes*, *Aſſes* and *Mules* are *ſingle*, and are not of ſo hard a Subſtance as the former. The *double-hooſ'd* or *Cloven-footed* Tribe have their *Feet* caſed with Subſtances of a *Horny* Nature; of which Claſs is the *Wild Boar*, *Stag*, *Fallow-deer*, *Sheep*, *Goat*, and *Kine*. In one Kind indeed of the *Hog* Race, which I have obſerved at the late Earl of *Stamford's*, the *Hoofs* are not cloven or divided; but it is remarkable, that if a *Sow* of that Breed is Coupled with a *Boar* of the *Cloven-footed* Kind, ſome of the *Pigs* will be *Cloven-footed*, and others *ſingle-hooſ'd*.

Of the *Horn'd* Race, the *Buck* is one of thoſe Creatures which ſheds his *Horns* every Year, and is not longer than three Months renewing them again, which is a kind of Vegetation equal to the quickeſt growing *Plant*. The *Stag* and ſome other ſorts of *Deer* are ſubject to ſhedding and renewing their *Horns* annually, like the former; and in the larger Kinds are ſometimes of that Extent, that in a direct Line they meaſure from Tip to Tip above a Yard: they are ſo ſolid and hard when they are fully perfected, and of ſo large a Size, that one would wonder how poſſibly the Body of the *Animal*, that produces them, could furniſh Juices enough to fill and explain them to ſo great a Bulk in ſo ſhort a time. I am not unſenſible that there are particular Names and Terms of Art for every reſpective Part of theſe branched *Horns* of *Deer*; but I confeſs my ſelf at preſent ignorant of them, that Knowledge being of little Uſe either to my Reader or my ſelf, in a Work of this kind. It is remarkable in the *Deer* Kind, that the *Females* have no *Horns*, which I ſuppoſe is common with thoſe Creatures whoſe *Males* ſhed their *Horns* every Year.

The next Kind of *Horned Animal* is the *Gazella*, or *Antelope*, whoſe *Horns* are erect, and twiſting like a Screw; theſe are not branch'd, nor do I find they ever ſhed. After theſe the

Goat has his *Horns* twiſted, and the Points bending towards his Back, but not both of them alike. The next is the *Sheep*, whoſe *Horns*, like the former, are twiſted, and regularly curl'd. It is obſervable, that the *Horns* of theſe laſt Kinds are always larger in the *Males* than in the *Females*; but it is otherwiſe among Kine, whoſe *Horns* are ſmooth, and of large Extent; in theſe the *Females* have *Horns* much larger and longer than the *Males*, unleſs they have been caſtrated; in ſuch *Oxen* I have meaſur'd a Yard between the extream Points of the *Horns*.

The Food of four-footed Beaſts is either *Fleſh*, *Fowl*, *Herb*, *Grain*, or *Fiſh*. Such as feed up *Fleſh* are Beaſts of Prey, and of the moſt Savage Kind, as *Lions*, *Tigers*, &c. whoſe *Talons* are chiefly deſigned for Catching and Tearing their Prey to pieces. The *Otter* and *Beaver* feed chiefly upon *Fiſh*, which their *Amphibious* Nature and Structure of Parts enables them to catch. The *Hog* Kind eats indifferently of *Fleſh*, *Fiſh*, *Fowl*, *Roots*, *Fruits*, *Herbs* and *Grain*. The *Deer* Kind, *Sheep*, *Goats*, *Kine*, *Horſes*, and ſuch generally as are of the *Hoof'd* Race, feed upon *Graſs*, *Hay*, or *Corn*. And it may be remark'd, that ſuch as uſe the latter kind of Diet are the moſt tameable and familiar with Mankind; but ſuch as feed upon raw *Fleſh* are poſitive in their Ferocity, unleſs they are familiarized when they are very young, and kept low in their Diet.

The *Quadrupedes* of Uſe and Service to Mankind are the *Elephant*, *Camel*, *Horſe*, *Kine* of all ſorts, *Sheep*, *Dogs*, *Cats*, and ſome others. Where *Elephants* are naturally placed, they are of great Uſe after they are tamed, in tranſporting of great Burdens, and carrying Men to Battle, where their Conduct and Strength is of extraordinary Service, if we may believe thoſe Authors who have mention'd them. We have now one of them in *London*, who is ſo obſervant of the Orders of his Keeper, that one may reaſonably place him amongſt the moſt tameable of the four-footed *Animals*; and even allow him a Share of natural Senſe, at leaſt equal, if not ſuperior, to any of the four-footed Race.

The *Elephant*, now in Town, is about twenty eight Months old; and about fourteen Hands and a half in height; his *Tusks* or (rather) *Horns* are now beginning to appear, or bud in the upper Jaw, which gives me Occaſion to ſuppoſe them rather *Horns* than *Teeth*; and again, conſidering what vaſt Numbers of them are annually brought into *Europe*, I am almoſt perſwaded they ſhed like the *Horns* of *Deer*. It is remarkable in this Creature, that the Joints in the *hind Legs* are diſpoſed for kneeling, as well as thoſe in the *fore Legs*, which is contrary to other *Animals*. Its Method of Drinking, is by ſucking its *Trunk* full of Liquor, and ſquirting it down its Throat. But we may ſee a large Deſcription of this Creature of a greater Age, and in more perfect State, with the Anatomy of it, in the *Phil. Tranſ.* N° 326, and 327, by Dr. *Blair*, F.R.S.

The *Camel* and *Dromedary* we have likewiſe had in *England*; they are *Beaſts* of Burden, and very ſwift; and it is reported of them that they will live many Days without Water, even in the hotteſt Climates. Some Creatures indeed I know will live without any Water at all, as the *Hare* and *Coney*, which I have kept above three Years, and they have never had any.

There are many Kinds of *Horſes* remarkably diſtinguiſh'd for their different Uſes. In *Northamptonſhire*, and ſome of the *Midland* Counties, are ſuch as are fit for the Coach, and drawing of other Carriages. In *Flanders*, *Denmark*, and ſome of the Northern Countries, we likewiſe find *Horſes* of Draught, differing in their Frame and Turn of Body, and varying in their degree of Strength, as the Countries they were bred up in differ from one another. In the North Parts of *Britain*, and ſome Places in *Wales*, are bred the beſt *Horſes* for the Saddle. The firſt State of their Life being among the Mountains, enables them to endure hard Labour. Beſides theſe, the *Spaniſh Horſes* are counted the moſt famous for the Parade; and the *Turkiſh* and

Barb Kinds, for Beauty, are reckoned to exceed moſt *Horſes* in the World.

Next to theſe the *Kine* Race is accounted the moſt uſeful. In many Parts of *England Oxen* are of great Service in Ploughing, drawing of Carriages, and for many other Works in Husbandry; beſides the Service of their *Fleſh*, after they are worn out by Labour, and the excellent Uſes of their *Hides* and *Tallow*, and even their *Horns* for making neceſſary Utenſils; while the *Cows* afford us *Milk*, *Cheeſe* and *Butter*, not only enough for our own Uſe, but even to ſupply the Neighbouring Countries. Nor are *Sheep* leſs uſeful to Mankind, their *Annual* Produce of *Wool* ſerving to employ as many People as their *Fleſh* can maintain in ſome Places of *England*. Their *Milk* is likewiſe made uſe of, and turns to good Account; to which we might add the Service of their *Skins*, which afford us *Leather*, *Parchment*, and *Vellum*.

Of the *Dog* Kind we have many different Sorts, ſuch as *Greyhounds*, *Blood-hounds*, *Beagles*, and others, for Hunting and taking of Game: And again, our *Spaniels*, either for Land or Water, *Setting-Dogs*, *Pointers*, &c. ſerve to find out Sport for their Maſters; and ſome of them are even uſeful for Draught and Carriage. In *Holland* and *Flanders* eſpecially, they are commonly employ'd in the Harneſs for drawing ſmall Waggons and other Carriages. To theſe we may add ſuch other Kinds of *Dogs* as are uſed for the Guard of Houſes, among which the *Engliſh Bull-Dog* is the higheſt in Eſteem, for his exceeding Fierceneſs and Reſolution.

The Voice of all theſe Creatures is as various as the Structure of their Mouths and Throats is different. We may diſcover each Kind of them by their Note or Tone, as well as diſtinguiſh one *Bird* from another by the Difference of their Song. The Parts which relate to this kind of Speech among them, are like ſo many Inſtruments of Muſick producing different kinds of Tones.

We might likewiſe mention how aptly all Kinds of *Dogs* are diſpoſed to receive Inſtruction, and how obſervant they are to the Dictates of their Maſter.

The *Apes* and *Monkeys* of ſeveral Kinds are naturally diſpoſed to imitate the Actions of Men; but indeed the Figure and Diſpoſition of their Parts agree much more with thoſe in Mankind, than the Parts of any other Creature; and I believe ſome ſorts of them might be rendred uſeful, if convenient Care was taken to inſtruct them when they were young. One ſort indeed, which comes from the *Eaſt Indies*, is very vicious; and I remember has more than once attempted to force a Servant of the Houſe were he was kept: But I am informed that ſome of the larger Kinds have been ſo well inſtructed, that they would do many little Offices that their Maſter directed them to do. It is no difficult Matter to be ſatisfied how much theſe Creatures are capable of Inſtruction, ſince there are ſo many of them daily brought to *England*. They are great Lovers of ſtrong Liquors, and frequently are inebriated with them. They love *Tobacco*, and ſmoak abundantly if they can get at it. Nor is the *Man-Tiger* leſs guilty of theſe Vices when he has Opportunity; his lower Parts are like thoſe of a *Monkey*, but his Head is more like that of the *Hog*, and is a Creature very ready to imitate the Actions of Men. The *Females* of theſe have periodical Viſits, like *Females* of the Human Race. I conclude, that as the different Tone of Voices proceeds from the different Structures of the *Organs* of Sound in *Animals*, ſo the Difference of their Capacity and Underſtanding proceeds from the various Frames of thoſe Parts which furniſh the *Brain* with nouriſhing Juices.

All *Quadrupedes* generate by coupling one with another; but are differently impower'd by Nature to increaſe more or leſs their ſeveral Species. Some of the larger Kind, ſuch as the *Elephant*, *Horſe*, *Kine*, and *Deer*, ſeldom bring more than one or two at a time; whereas the ſmaller Kinds of *Animals*, and ſuch as are ſubject to be deſtroy'd, encreaſe more plentifully. The *Hog*

Kind will ſometimes bring ſeventeen or eighteen young ones at a Birth, and the *Dog* Race about ten, *Cats* and *Rabits* about five a-piece, *Rats* and *Mice* about eight or nine a-piece, *Squirrels* three or four, *Hares* two or three, and *Sheep* ſometimes as many. And with regard to the Generation of theſe Creatures, the natural Time of Coupling is in the Spring Seaſon, ſomewhat later than *Birds*; but by means of forcing Diet, ſome of them may be brought to couple even in the Depth of Winter; 'tis by that Means that we have now young *Lambs* at almoſt every Seaſon of the Year; and ſome Creatures, as well in this as in the *Bird* Kind, couple and bring forth young ones ſeven or eight times in a Year, as the *Rabit* for Example, and ſome others. We may alſo remark, that every *Quadrupede* has not the ſame Length of Time appointed for its Growth to its compleat State: The large Kinds, ſuch as *Horſes* and *Kine*, are hardly full grown in three Years, *Hares* and *Rabits* about eight Months, *Cats* and *Dogs* twelve Months, which perhaps may depend, in great meaſure, upon the Length of Time they are reſpectively maintain'd in the Womb of their *Dams*; but every Kind of *Bird* grows to its full Bigneſs in a few Months; and ſome Kinds of *Fowls* are about a Year accompliſhing their Growth; which Difference I ſuppoſe happens as the Difference of Time is appointed, more or leſs, for the Incubation and Hatching of their *Eggs*, ſome ſetting only three Weeks, and others a Month, before the young ones are excluded, or can make their way through their *Egg-ſhells*. And I believe the Length of Life allotted for ſeveral *Animals* is various, as the Time of their being included in the Bodies of their *Dams* is more or leſs. There are ſome of the larger Kind of Creatures which carry their young ones many Months, as the *Mare*, *Cow*, and the *Elephant*, as it is ſaid, longer than any other Creature; but *Rabits* do not go above a Month, *Cats* about twice as long: and I believe, was it poſſible to know the Nature of all Creatures, we might find, according to their Proportion and different Habit of Body, a continued Progreſſion, with regard to their Size, Growth and Length of Life. For in *Plants*, which I have been more converſant with, I obſerve that kind of Progreſſion; and even it is to be remark'd, that the ſeveral *Seeds* which they ſpring from, have as different degrees of Time appointed for their hatching or ſprouting in the Earth; and likewiſe ſuch as lie longeſt under Ground without ſhooting, are commonly more laſting than thoſe which begin to ſhoot in a few Days; and we may obſerve ſomething of the ſame kind in *Inſects*. The Diſtance of Time between the laying and the hatching of the *Eggs* laid by ſome ſorts, is very different from what we obſerve in others; and the Time of Life in the *Caterpillar* of one Kind, is not the ſame that we obſerve in another, no more than the number of Days is the ſame in all, for bringing the ſeveral *Flies* out of their *Cryſaliſes*.

But it remains for me to ſay ſomething more particular of the Generation of four-footed *Animals*, as it is the next relating, and in ſome Caſes is nearly agreeing with that of Mankind. Were we to look back upon what I have already mentioned concerning the Generation of *Fowls*, *Fiſh*, and *Plants*, and even of ſome Creatures of the four-footed Tribe which are cover'd with *Scales*, it will appear that the *Eggs* of the *Females* are abſolutely neceſſary for the Production of them; and I ſuppoſe that the fecundating *Liquor* or *Duſt* of the *Male* is as neceſſary to make them prolifick. In this Race of *Animals* every *Female* has its *Ovaries*, or *Egg-Neſts*, which, without the Intromition of the prolifick Juice of the *Male*, remains ſterile or barren: It therefore appears that the *Male Liquor* is neceſſary to impregnate the *Eggs* contained in thoſe *Ovaries*, either by ſome *Animalcules* of it paſſing into the *Eggs* there contained; or elſe that the *Animalcules* wound thoſe *Eggs*, and ſo occaſion them to grow over, and encloſe them in ſuch a manner, as the Bliſters upon *Oaken Leaves* ſwell and encloſe the little *Inſects*, whoſe *Eggs* are laid in the wounded Parts by their Originals: But this Caſe has admitted of vaſt Diſpute, either becauſe ſome of the Diſputants could not imagine how the *Animalcula* could get into the *Ovaries*; or elſe that ſome ſuppoſe there is not Paſſage ſufficient for the impregnated *Egg* to fall into the *Matrix*; but theſe I ſuppoſe draw their Judgments from the State of thoſe Parts when the *Animal* is dead, which, in my Opinion, muſt then be very different from what they were when the *Animal* was alive; for then theſe as well as all other Parts of the Body have a Power of contracting or dilating themſelves; and a Paſſage, which at one time is hardly capable of admitting the Point of a Pin, may probably be capable of being dilated ſo much as to give room for the Excluſion of a full grown *Fœtus*; and certainly it would be very unreaſonable to ſuppoſe theſe Parts are in the ſame Poſture during Coition, that they are at another time when the Body is not diſpoſed for it; at which time it is highly probable Nature has given thoſe Parts a different Action and Power of extending themſelves. I could ſay much more of this, if the Caſe had not already been ſo much perplex'd; and I am loth to truſt too far to my own Opinion, in an Affair of ſo much Difficulty. However, that I may not leave my Reader altogether unſatisfied in a Point of ſo great Concern, I ſhall entertain him for a while with what has paſt by way of Letter concerning this Subject, between Dr. *Geoffroy* of the Royal Academy of *Paris*, and Dr. *Andry* of the ſame Place.

Dr. *Geoffroy* tells us, that ſuch as ſupport the Syſtem of *Eggs* in all Creatures, ſuppoſe the little *Animal* to be included in the *Egg*; but this they cannot demonſtrate till after Fecundation: Alſo they ſuppoſe the little *Germs* of *Plants* to be encloſed in the *Seeds*; but theſe Rudiments of the *Plant* in the *Seeds* cannot be diſcovered till after Impregnation by the *Farina* iſſuing from the *Male* Parts. On the contrary, if we examine the *Eggs* of *Animals* before they have been rendred fecund by the *Male*, we cannot obſerve the leaſt Principle of the *Animal*. In the *Eggs* which the *Hens* lay without a *Cock*, although they appear fair, and as large as the others, yet nevertheleſs we can only diſcern in them an empty *Cicatricula*, in which the little Body is not reſiding. Thoſe who have had the Management of *Silk-Worms* may remark, that when a *Moth* has laid its *Eggs* without the Aſſiſtance of the *Male*, thoſe *Eggs* are tranſparent and void of that little black Point which we diſcover in ſuch *Eggs* as are fecundated, and is the beginning of the little *Worm* or *Caterpillar*, 'tis therefore we are not to expect any good from thoſe tranſparent and barren *Eggs*. It happens ſometimes that we meet with theſe tranſparent *Eggs* among thoſe that are impregnated, even tho' they were all laid by the ſame *Moth*, which muſt proceed from ſome particular Cauſe in the Coupling of the *Male* with the *Female*.

We may likewiſe obſerve the ſame thing in the *Grains* and *Seeds* of *Plants*; we often meet with *Seeds* that are without the *Germe* or *Seed-bud*, and are conſequently barren, and theſe are found even in the middle of the faireſt Fruits. If we obſerve likewiſe the *Seeds* of any *Plant* at the firſt opening of the *Flower*, we find them clear and tranſparent; but if we examine them ſome time after the *Flower* is decayed, that is to ſay, after their Fecundation, thoſe *Seeds* become *Opaque*, by means of a little Body encloſed, which is properly the *Germe* or *Seed-bud*.

The *Ovariſts* ſuppoſe that theſe *Germs* were originally in the *Seeds*, and that they are now only grown bigger than they were at firſt; but this is a bare Suppoſition; for ſince we cannot diſcover this Point by the beſt *Microſcopes*, either in *Eggs* or *Seeds*, before they have been fecundated, and that it may be eaſily diſcover'd after Coition, it is more natural to believe that thoſe *Germs* were not ſubſiſting in the *Eggs* or *Seeds* before they were impregnated, but from the very Inſtant of their Fecundation. To convince us of what I advance, we are only to conſider what happens in the Time of Fecundation among *Animals*.

Among thoſe *Fiſh* which do not couple, the generative *Liquor* of the *Male* is only ſcattered upon the *Eggs* which have been laid by the *Female*, while they flit in the Water. In other *Animals*, where Things cannot be obſerved in the ſame manner, we know only that the *Liquor* of the *Male* is conveyed into the Cavity of the *Matrix*, even as far as the *Phalopian Tubes*, where it is often found in ſuch *Animals* as have been opened a little while after Coition; and we may preſume that it even paſſes into the *Ovaries*, and ſprinkles ſome of the *Eggs* of the *Female*. It appears then that Impregnation proceeds from an Effuſion of the *Male Liquor* upon the *Egg*; from whence we may naturally conclude, that the Effect produced by this *Liquor* upon the *Eggs*, is chiefly to convey the little *Germ* or *Animalcule*, which is found in the *Egg* after that time, and the rather, becauſe the *Animalcule* may always be obſerved in that fecundating *Liquor*.

And we have yet more reaſon to believe that theſe *Animalcules*, which abound in the *Male Liquor*, are the Principles of Generation, or the Beginning of Man, and other *Animals*, as we find them always conſtant in the *Liquors* which are included in the *Spermatick* Veſſels of every *Animal*, varying according to their different Species; but we ſometimes find them wanting in thoſe *Liquors*, either through extreme Age, or when Diſtempers have rendred them barren.

The Syſtem of the Generation of *Animals* being thus ſtated, we ſhall reaſon only upon conſtant Facts; whereas the *Ovariſts* ſuppoſe that the Rudiments of the *Animal* are always in the *Egg*, although they cannot ſee them, and moreover, that there is a fecundating Spirit in the Generative *Liquor* of the *Male*; but theſe are uncertain Suppoſitions; for according to them this *Seminal* Spirit muſt be exceeding *Subtile* and *Volatile*: And nevertheleſs, among the *Aquatick Animals*, this Spirit, however *Volatile* it is, is neither enervated nor diſſipated by the Waters with which this *Liquor* mixes it ſelf; but this is altogether impoſſible.

poſſible. The greateſt part of *Fiſh* do not couple, but the *Females* caſt their *Eggs* or *Spawn*, and the *Males* which follow them ſcatter their *Milt* over the *Eggs*. Now before the Waters have extended this *Liquor* over all the *Spawn*, it muſt neceſſarily happen that the fecundating Spirit is diſſipated. The Difficulty of Impregnation is ſtill more conſiderable in *Oyſters* and other *Shell-Fiſh*, which are faſtned to Rocks, or the Bottom of the Sea, without having little or any Motion. The *Milt* of the *Males* is carried backwards and forwards at the Will of the Waters, and at laſt by chance is brought to the *Eggs* of the *Females*, and renders them fecund. What will then become of this *Seminal* Spirit, when it is toſſed about from place to place? If Generation was brought about by its Means, it would ſurely have time enough to exhale, and then the *Eggs* of *Oyſters* and other ſuch like *Shell-Fiſh* could not be impregnated by it.

But we ſhall avoid theſe two Suppoſitions in our Syſtem, and endeavour to produce more ſolid Arguments for the Generation of *Animals* than the *Ovariſts* have done. And firſt let us examine if the Generation of *Plants* does not carry along with it ſome Analogy to that in *Animals*.

Till the *Flower* begins to fade, we cannot perceive any *Body* or *Germe* of a *Plant* in the *Embrios* of the *Seeds*, or *Seminal* Veſſels; nor can we diſcern any Change in thoſe *Embrio's* till the *Duſt* of the *Stamina* is fallen.

This *Duſt* of the *Stamina* is neceſſary for Fecundation; for, in all *Plants* where theſe *Stamina* appear, if we cut them off before they open, the *Fruits* will not come to Maturity; or if they ſhould happen to ripen, they are without *Germs*, and are conſequently barren.

The Neceſſity of this *Duſt* of the *Stamina* for the Growth of the *Seeds*, for the bringing of them to Maturity, and for making them pregnant, is confirm'd by the Obſervations of all *Botaniſts* upon the *Palm* or *Date Tree*.

This ſort of *Plant* bears its *Stamina* upon a different *Tree* from that which bears the *Fruit*; ſo that one is ſtiled *Male*, and the other *Female*. *Theophraſtus*, *Proſper Alpinus*, and all the *Botaniſts* agree, that if a *Female Tree* has not a *Male* in its Neighbourhood it does not bring forth *Fruit*, or if it bears any, they rarely come to Maturity; they are ill taſted, and without *Kernels*, and conſequently without *Germs*: But to bring this *Fruit* to Perfection, and make it fit to eat, Care is always taken either to plant a *Male Palm-Tree* in the Neighbourhood, or to cut *Branches* of the *Male Palm-Tree*, garniſh'd with *Stamina*, and tie them to the *Branches* of the *Female Palm-Tree*, and then it produces good *Fruit*. This Obſervation was confirmed to Monſieur *Tournefort* in 1697, by *Hadgi Muſtapha Aga*, a curious Man, Ambaſſador from *Tripoli* to the King of *France*.

There is one Objection which may be made againſt what we have mentioned concerning the *Palm-Trees*; Monſieur *Tournefort* tells us that he has ſeen a *Female Plant* of *Hops* produce *Seed* in the King's Garden, where there was never a *Male Plant*. But we may ſuppoſe that the *Farina* or *Male Duſt* was brought to the *Female Plant* by the Wind from ſome other Place; as in the Caſe mentioned by *Jovianus Pontanus*, Preceptor to *Alphonſo* King of *Naples*, who tells us, that in his Time there were two *Palm-Trees*, one of them *Male*, cultivated at *Brindes*, and the other *Female*, growing in the Wood of *Ottranto*; that this laſt was ſeveral Years without bearing any *Fruit*, till at length having out-grown and rais'd its Head above the other *Trees* of the Foreſt, it could perceive, ſays the Poet, the *Male Palm-Tree* at *Brindes*, although they were ſeveral Leagues aſunder, for then it began to bear *Fruit* in abundance; and there is no Reaſon to doubt but it then begun to bear *Fruit*, becauſe it then received the *Duſt* of the *Stamina* upon its *Branches*, which was conveyed by the Wind from the *Male Palm*. We may explain by this, in a natural manner, that *Fecundity*, which ſo much embaraſs'd the antient Phyſicians, and which they attributed to a Sympathy, or Love among *Trees.* *Engliſh'd* thus from the Author's Original.

A Female Palm *for many Years had ſtood,*
The Virgin Glory of Ottranto's *Wood.*
No vernal Bloom with Flowers *her* Branches *dreſs'd*;
No Cluſters *her unfruitful* Boughs *depreſs'd.*
Till diſtant far, in Brindiſi's *fair Vale*
Aſpiring, ſhe beheld the noble Male.
Tho' diſtant, yet the genial Power ſhe feels;
Thro' every Vein the fertile Humour trills.
The pregnant Branches *now their* Bloſſoms *yield,*
And every Bough *with ripening* Fruit *is fill'd.*

It may be objected, that I have no ſufficient Proof, that every Grain of this *Duſt* is a *Plantula* or *Germ*, ſince the *Microſcope* ſhews us that each Grain is in the Form of a little *Globe* or *Egg*, either ſmooth, or ſet with Points, ſometimes bor'd through the Middle, or of ſome other Form or Manner. I agree that it is difficult to diſtinguiſh in every one of theſe little Grains of *Duſt* the Rudiment of a *Plant*, becauſe it is wrapt up in its ſelf, and perhaps may be covered with a *Membrane*, or at leaſt cloathed with ſome *Reſinous* Matter; perhaps Time may diſcover ſome way of unfolding the little *Germ*, or freeing it of its Covering; but allowing this to be only a bare Suppoſition, we may agree that it is not altogether unreaſonable, ſince it is not till after the Intromiſſion of theſe little Bodies into the *Piſtillum* or *Uterus* of the *Flower*, that we can perceive any *Opacity* in the *Seminal Veſſels* or *Embrio's* of the *Seeds*, which in their Growth diſcovers to us that they are in effect the *Germs of Plants.*

In ſhort, what confirms this *Hypotheſis* is its Uniformity with what we have diſcovered relating to the Generation of all living Bodies.

After having eſtabliſh'd the Proofs of our *Hypotheſis*, I am to anſwer the Objections which may be made againſt it.

Firſt, It may be objected that an *Inſect* cannot quit its Nature, as an *Inſect*, to take upon it that of a *perfect Animal.*

It is an antient Error to make the Diſtinction of *Perfect* and *Imperfect Animals*. Our Eyes do not diſcover the ſame Parts that are in ſome *Animals*, in *Worms*, *Butterflies*, *Flies*, *Bees*, and other *Inſects*; ſo that ſome have thought ſuch Parts were wanting. We ſee them take their Birth in *Mud*, *Dunghills*, *putrified Fleſh*, and *rotted Herbs*; which has made ſome believe that theſe little Bodies had no other Origin than a *Fortuitous Aſſemblage of putrifying Parts of Matter*. They have even believed that larger *Animals*, ſuch as *Frogs*, *Wild Ducks*, &c. had the like Beginning, without reflecting that thoſe *Animals* were conſtant in their Frame and Parts, which are always produced alike; and that it is impoſſible that Chance could produce an Arangement of Parts always uniform and conſtant. We are obliged to the learned Mr. *Redi*, for having firſt ſet this Matter to rights, by giving us Proof that the Generation of *Inſects* comes from *Males* and *Females*, agreeable to the Syſtem of *Eggs*, as it is among all other *Animals*. Many learned Phyſicians, and particularly Monſieur *Swammerdam*, have begun the *Anatomy of Inſects*; and we are obliged to that great Man for having ſhewn us that thoſe little *Animals* had Parts agreeable to ours, or at leaſt did the ſame Functions; but as that Work was left unfiniſhed, Monſieur *Duverney* has taken it up, and continues it with great Accuracy and Judgment, tracing thoſe little Creatures from the Beginning to the End; and far from repreſenting *Inſects* as *Imperfect Animals*, he diſcovers ſo much Art and Contrivance in their Structure, that they ſeem to be even more *Perfect* than the moſt conſiderable *Animals*. In *Caterpillars*, and ſuch *Worms* as change into *Butterflies*, and in ſuch *Reptiles* as take *Wing*, it is ſurpriſing to obſerve the Changes which happen throughout the interior Structure of their little Bodies. An infinite Number of Parts, which were folded up, explain and open themſelves at the End of a certain time; ſome become abſolutely uſeleſs, dry up, and fall off; and others are alter'd beyond our Knowledge. Nothing can be more admirable than the Tracing of all theſe Changes. A *Frog* is a *Fiſh* in its Beginning, named *Tadpole*; it has a great Head, the Mouth of a *Fiſh*, the Finns and Tail like *Fiſhes*; it reſpires by the *Gills*, which are *Lungs* peculiar to *Fiſhes*; ſome time afterward its *Tail* and *Finns* drop off, and its *Feet* appear, which are as well adapted to Walking as Swimming; the Fore-part of its *Head*, or rather its *Mask*, falls off, with its *Gills*; in the mean while, the *Lungs*, which reſemble thoſe in terreſtrial *Animals*, unfold and dilate themſelves, and become expanded and very viſible, from almoſt inviſible Parts that they were before. May not we look upon this as an extraordinary Perfection, and even more than Man himſelf can boaſt of, that Gift of Power in taſting Life ſucceſſively in different States and in dfferent Elements?

Theſe Conſiderations may undeceive thoſe who are prejudiced in their Opinions, that a Creature in the Rank of *Inſects* cannot become a *perfect Animal*, eſpecially if they reflect that for the moſt part the State of *Worms* or *Caterpillars* is only a State of Paſſage to bring them to another Form; ſo that thoſe *Worms* which are commonly ingender'd in *putrify'd Fleſh*, change into *Flies*; likewiſe ſeveral great *Worms*, which remain ſome time under Ground, change into *Beetles*; *Silk-Worms*, and *Caterpillars*, become *Moths* and *Butterflies*; and I think the *Earth-Worm* is the only Species which does not ſuffer a *Metamorphoſis*.

This being premiſed, we may regard the Form of the *Worm* or *Animalcule* in the Generative *Liquor* of *Animals*, as an Inſtance of the Certainty of a future *Metamorphoſis*.

It may be objected in the ſecond place, that I attribute an imaginary Inſtinct to the little *Animal* or *Animalcule*, to make it riſe into its Cell. I confeſs the Difficulty of explaining ſo great a Myſtery as that of Generation, without meeting a thouſand Obſtructions and Queſtions, which cannot be reſolved without great Pains and Trouble; but when an Effect is ſo evident that it meets with no formal Oppoſition, it does not ſeem reaſonable to conteſt it; ſuch is the Difficulty in Diſpute. Inſtinct in this place is not the Queſtion; for I have not attributed it to the little *Animal* as a Means whereby it is convey'd into its Cell. I know too well, that in Phyſical Diſputes we muſt make uſe of Mechanick Laws, and I ſhall endeavour to give ſuch as are moſt probable.

The prodigious Multitude of *Animalcules* ſwimming in this Liquor, which diſpoſes it ſelf to overflow the *Egg* that is prepared to be impregnated, makes it almoſt impoſſible, that one of them at leaſt ſhould not reach the little opening of the *Cicatricula*; and that from this prodigious Multitude there is not above one which can find place; for the *Cicatricula* is not capable of containing any more; but if by chance it is big enough to admit of two, we ſhall find two *Fœtus* under the ſame Covering, or elſe a monſtrous double *Fœtus* joined together by ſome part of the Body. This is one Proof of the Authority of this Syſtem.

Thirdly, It may be ſaid that we carry our Thoughts too far, in ſuppoſing theſe little *Animalcules* to be the Principles or firſt Points from whence Mankind is derived, and that they may have been appointed to ſwim in the *Seminal Liquor* for other Uſes: as for Example: They may be ſuppoſed to agitate that *Liquor*, and to facilitate the *Exhalation* of the *Spirits*.

Beſides what I have already obſerved of thoſe who ſuppoſe a powerful *Spirit* in this *Liquor*, it ſeems much more natural to me to draw this Conſequence (*i. e.*) That the *Animalcules* which are found in ſuch vaſt Numbers floating in a *Liquor* ſo neceſſary for Generation, are themſelves the immediate Cauſe of Generation, and not to believe that they are only remote Inſtruments of it; becauſe we do not diſcover any nearer Cauſe. After this the Uſe which is aſſigned them is far from neceſſary, and there is no Likelihood that there is any Probability in it; for every thing that is *Liquid* has in its ſelf a motive Power, without having Occaſion of ſuch feeble Aſſiſtance, as that which it might receive from *Animals* moving in it; for is it not reaſonable to ſuppoſe that *Fiſh* were created in the Seas, or *Birds* were made to move in the Air, to prevent the Stagnation of thoſe *Liquids?* the one is not more plauſible than the other.

Fourthly, It is ſaid that Conception, by means of the *Animalcule*, is diſagreeable to the Syſtem of the unfolding of the Veſſels and Parts. But wherein is this Syſtem of Unfolding more attack'd in this *Hypotheſis*, than in the common Sentiment of the *Eggs?* If we admit that *Adam* had in himſelf all the *Animalcules*, as it were, incaſed one within the other; do not alſo the *Ovariſts* ſuppoſe in the ſame manner that all their *Eggs* were encloſed one in another, and contained in the Body of *Eve?* They cannot therefore make any Objections upon that Account, ſince we may as eaſily oppoſe their Opinion of the *Eggs*. But to defend both theſe Opinions againſt thoſe who are too much embarraſs'd by the Syſtem of Unfolding of Parts, let them join with me, and conſider how Nature acts in her Courſe, and they will ſee how the Syſtem of the Unfolding of Parts is incumbred, but at the ſame time muſt agree to the Truth of it. But let us now examine what Mr. *Dodart* ſays upon the *Fecundity* or *Encreaſe of Plants*, in his Memoirs, inſerted in thoſe of the *Royal Academy of Sciences for the Year* 1700. It is wonderful, ſays he, that the *Fecundity* or *Encreaſe of Plants* has been ſo little obſerved by the World, eſpecially ſince they are ſo commonly expoſed to the Eyes of all People; not only the *Natural Encreaſe of Plants* of their own accord, but alſo their *Artificial Encreaſe*, produced by Cutting or Amputation of their ſeveral Parts. This *Artificial Encreaſe* he proves to be no more than *Natural*; for, as he obſerves, the Art of a Gardener cannot give to *Plants* what they had not in themſelves, his Art only aſſiſts them to unfold and explain thoſe Parts which they were originally poſſeſs'd of. Here follows an Example of the Encreaſe and Multiplication of a *Tree* by the *Seed* only, which is the laſt Term and Object of all the Productions of a *Tree*.

He ſays that the *Branches* of the *Elm* are ſo many *Bunches* of *Seeds* or *Grains* extremely preſs'd one againſt the other; and having taken an *Elm* of ſix Inches Diameter, and twenty Foot high in *Stem*, which was about twelve Years old, he cut off a *Branch* of eight Foot long; and neglecting the *Seeds* which had been ſhaken off by the repeated Blows of the Axe, and the Fall of the *Branch*, he yet found remaining on it 16450 *Seeds*.

We may ſuppoſe that an *Elm* of ſix Inches Diameter muſt carry more than ten *Branches* eight Foot long; but ſuppoſe ten only, then theſe ten *Branches* may reaſonably produce, according to the above Account, 164500 *Seeds*. All the *Branches* which are leſs than eight Foot long, taken together, make a Surface more than double the Surface of the ten *Branches* of eight Foot; but ſuppoſing them only double, becauſe perhaps theſe leſſer *Branches* are not ſo prolifick as the others, then all the *Branches* together produce 329000 *Seeds*.

An *Elm* may be ſuppoſed to live an hundred Years; and it is not reaſonable to ſuppoſe that the mean State of its Fertility ſhould be at the Age of twelve Years; we may then juſtly reckon, that in an indifferent bearing Year it will produce 329000, or may well enough ſuppoſe 330000 *Seeds*, which are little enough. Again, we muſt multiply this 330000 by the hundred Years Life of the *Elm*, which makes 33000000 of *Seeds*, which an *Elm* produces in its whole Life-time, taking every thing at the loweſt rate, and theſe 33000000 came all from one ſingle *Seed*.

But this is only the natural Production of the *Tree*, which hath not yet produced all that it contains.

If the *Tree* had been headed it would have ſprouted afreſh from the Trunk, and at leaſt produced as many *Branches* as it had before in its natural State; and theſe new Shoots would not require more than the Space of ſix Lines, or thereabouts, in heighth of the Extremity of the headed Trunk to ſhoot from.

At whatever Place, or whatever Heighth the *Tree* had been headed, it would have alway regerminated with equal Vigour; which is conſtant, as appears by the Example of *Dwarf Trees*, which are continually kept cut almoſt down to the Ground.

From hence we learn, that all the Trunk of a *Tree*, from the Earth, to the firſt germinating of the collateral *Branches*, is fill'd with Principles or little *Embrio's* of *Branches*, which cannot poſſibly appear all at the ſame time; we conceive them to be parted by little circular Rings of ſix Lines in heighth, each of which in particular is ready to produce *Branches* as ſoon as an Amputation is made exactly above it.

All theſe inviſible *Branches* (although they are hidden) are no leſs exiſting than thoſe which appear to us; and if they were once manifeſt they would produce an equal Number of *Seeds*, which conſequently they muſt already contain in little.

Now were we to follow the Example propoſed, there is included in this *Elm* as many times 33000000 of *Seeds*, as there are Spaces of ſix Lines contain'd in the twenty Foot height of the *Stem*, that is to ſay, fifteen thouſand eight hundred and forty Millions of *Seeds*; and that this *Tree* contains actually in its ſelf wherewithal to multiply and reproduce ſuch a prodigious Quantity of *Plants* as would ſurpaſs all intelligible Numbers.

What will thoſe ſay to theſe Obſervations, who are afraid of over-burdening the Syſtem of unfolding of Parts? Will they not be forced to acknowledge that their Ideas are too narrow for the infinite Foreſight of the Creator in the Propagation of living Beings? But it is permitted at preſent, that our Reaſon even penetrates beyond its own Power, where the Senſes have carried us; and where they begin to abandon us, they will plainly diſcover, that whatever their Senſes have ſhewn them, is nothing in compariſon of that which may hereafter be found out; for if we only ſuppoſe that each Grain of a *Tree* contains in it ſelf a ſecond *Tree*, which again encloſes the ſame Number of *Seeds*; and that we can never diſcover a Grain which contains more *Trees*, nor a *Tree* which contains more or fewer *Seeds* than the preceding *Tree*; then conſequently there is a Geometrical Progreſſion of Growth, whoſe firſt Term is one; the ſecond 15840000000; the third the Square of 15840000000; the fourth its Cube, and ſo on, *ad infinitum*; ſo that our Reaſon and Imagination would in ſome ſort be loſt, and ſwallowed up in the immenſe Calculation.

This prodigious Chain of Numbers ſtrikes Terror in the Spirits of thoſe who are not uſed to puſh their Meditations to any great Length; but thoſe who are uſed to the Study of Phyſick and Mathematicks, know very well that they cannot go far without meeting ſome kind of Infinity, as if the Author of Nature had been careful that his principal Character ſhou'd reſide in every thing.

If then we agree with the Syſtem of unfolding of Parts in *Plants*, which I think there is no reaſon to doubt of, we may as eaſily admit the ſame in *Animals*, and it will be ſo much the more demonſtrable, as this Syſtem is the moſt ſimple of all others; for if we once ſuppoſe that all Things were created at one time, as it is ſeemingly intimated in that Paſſage of *Eccleſiaſticus* 18. *ver.* 1. *Deus creavit omnia ſimul*, we need not torment our ſelves to find out how organiz'd Bodies may form themſelves, which is no more than the unfolding and explaining of their Parts one after another; where, on the contrary, 'twill always be found as difficult to explain their *Fortuitous Formation*, as it will be to demonſtrate that *Gold*, *Silver*, *Copper*, *Steel*, and *Enamel*,

mel, being put into a Crucible, the Parts of each Matter would arange themſelves in ſuch a manner, as to form a Clock or Watch.

Fifthly, It is objected, that the *Animalcule* which begins to diſcover it ſelf in the *Egg* after Conception, is not a *Worm:* But this will be of Uſe to me in my Proofs.

I anſwer to that, That if we could open the *Cicatricula* of the *Egg* immediately after Conception, (that is to ſay, as ſoon as the *Worm* is entred into that part) we might diſcover that little *Animal* yet under the Form of a *Worm*; but as it begins to grow bigger almoſt as ſoon as it receives a new Nouriſhment in the *Egg*, and as new Parts begin at the ſame time to unfold themſelves in it, it is not ſtrange to find it then alter from the Form of a *Worm*; and we may obſerve the different States of its Paſſage from that Form, to that of the *Animal* which is to be produced.

With regard to the Obſervations of the *Fœtus*, whether it be formed in the *Ovaria*, or in other Parts of the *Matrix*, a very little while after Conception, thoſe Obſervations do not deſtroy my *Hypotheſis*. All that can be ſaid is, that the little *Animalcules*, which are the Principles of Mankind, loſe the Figure of *Worms* a little after they are entred the *Eggs*, and begin to take upon them the human Form: And as to that Obſervation of our learned Critick, that Nature gives the moſt *perfect Animals* a longer time of Ripening, or coming to their laſt State, although it is not a general Rule, yet nevertheleſs it happens to be true enough in Mankind.

Among the Obſervations of the *Fœtus* inſerted in the Memoirs of the Academy Royal, Mr. *Dodart*, in the Year 1701, has given us one of the moſt remarkable, of an *Embrio* of one and twenty Days; it was then but ſeven Lines in length; and it was difficult to diſtinguiſh its Parts; the *Head* and the *Trunk* of the Body only could be diſcerned; the *Thighs* and *Arms* were not yet unfolded;

folded; and the *Head* was one third of the whole Length. Can we then ſay that this *Embrio* had the perfect Figure of Mankind, or was entirely formed? and was it not in this State more like to a *Worm*, which it was originally, than to the Form of Man? For we may ſuppoſe that the *Head* of the little *Worm* was become the *Head* of the *Fœtus*, and that the reſt of the Body had been hidden in that part, which made the *Tail* of the ſame *Worm*; but here I may ſay that the *Worm* is not yet perfectly of the Form of Mankind (to ſpeak like our Author) at the End of nine Months, when he ſhould come into the World; for we may ſay that he is not in his perfect State till he is twenty Years old, which is about the time when an human Body has acquired all its Proportions; which agrees with the Account of our Critick, who will not be ſurpriſed, that a *Worm* may be changed into a *perfect Man* in ſo long a Space of Time.

Sixthly, In the next place they attack the *Syſtem of Plants*, and object, that the Diſpoſition of certain *Piſtils*, which lengthen themſelves beyond the *Apices*, cannot therefore admit of or receive the prolifick *Duſt*.

I agree that ſome *Piſtils* are much longer than the *Apices*, and have their *Orifices* a good Diſtance beyond them; but this only happens in reverſed *Flowers*, ſuch as the *Crown Imperial*, &c. where this Situation of the *Piſtillum* favours Fecundation; for in ſuch *Flowers* the *Duſt* cannot fall from the *Capſules* of the *Apices*, without falling upon the *Piſtils*, which, in ſome Subjects, are garniſhed with little *Hairs*, the better to retain the prolifick *Duſt*; beſides, moſt of them are endued with a *Glutinous* or *Viſcous* Matter. In the *Tulip*, and ſome other *Flowers*, the *Piſtillum* does not begin to raiſe it ſelf above the *Apices*, till they are full ripe, and have ſcattered their *Duſt*.

I agree that it is not ſufficient to prove only that the prolifick *Duſt* of the *Apices* may fall upon the *Piſtils* of the *Flowers*; we muſt conduct it even into the very *Cells* of the *Seeds*: And I own that it is very difficult to comprehend how this *Duſt* can get there; but becauſe we find a Difficulty in any thing, are we therefore to conclude it is impoſſible? and eſpecially when we may obſerve ſo much Preparation as we ſee in *Plants* towards the perfecting of the prolifick *Duſt* in the *Apices*; as alſo how it is ſcattered when it is full ripe, at a certain time, when the *Piſtils* are ready to receive it: May we not remark as much Difficulty in the Generation of *Animals?* when we find that the Entrance of the *Infundibulum* or *Vagina* of the *Matrix* in *Birds* is very diſtant from the *Ovaries*. One can hardly imagine how the *Eggs*, when they detatch themſelves from the *Ovaries*, ſeek out the Overtures of the *Vagina*, although there is no doubt but they do. So all the Garniture of *Flowers* may perſwade us of the Neceſſity of the prolifick *Duſt* for impregnating the *Seeds*; and the Proofs which I have already given may convince us of it. A few Obſervations, which Time may produce, will ſet this Matter in a clearer Light.

Seventhly, I am told that the *Bloſſoms* of an *Apricock Tree*, which were robb'd of the *Apices* by *Vermin*, produced good *Fruit*. But are they aſſured that all the *Apices* were entirely eaten, or whether they were deſtroyed before they had ſcattered abroad ſome of their *Duſt?*

Eighthly, We are not to ſuppoſe that the Wind can be an Intermitter in this kind of Fecundation.

But is it more difficult to ſuppoſe that the Air is an Intermitter in the Fecundation of *Plants*, than to make the Element of Water an Intermitter in the Propagation of *Fiſh*, and chiefly of *Oyſters* and other *Animals*, which lie *immovable* at the Bottom of the Sea?

Ninthly, They add, that if the little *Grains* of the prolifick *Duſt* were ſo many *Plants*, they would produce as many *Plants* as there were *Grains* falling upon the Earth. And why then don't they raiſe the ſame Difficulty in the *Liquor* deſign'd for the Propagation of *Animals?* for, in ſhort, if the little *Animal* or *Animalcule* does not meet with a convenient Nouriſhment in the Earth or Water to make it grow, and can only find what is neceſſary for its Support in the *Egg* of the *Female*; neither can the little *Germ* of the *Plant* meet with a proper Nouriſhment in the Earth to unfold its Parts, but only finds it in the *Embrio* of the *Seed*.

If my Reader will examine carefully, without Prejudice, the ſeveral Opinions upon the Generation of *Plants* and *Animals*, and weigh well the Proofs of one and the other, and obſerve the Difficulties which are to be met with in all theſe *Hypotheſes*, I doubt not but he will agree with ours, as it is the moſt general, and has leſs Suppoſitions than the others; and after all, I deſire him to obſerve that I lay this down only as an *Hypotheſis*, in which appears more Probability of Truth than any I have yet ſeen upon this Subject.

There are two Things yet remarkable in Generation after the *Eggs* are impregnated. In ſome *Animals* the *Eggs* are excluded from the Body of the *Females*, to be afterwards incubated and ſet upon, till the Creature is ſo far perfected as to break its way through the *Shell*, as in the Caſe of *Birds* and *Fowls*, which are therefore called *Oviparous*: but the Caſe of *Quadrupedes* is different; the *Fœtus* is not excluded from their Bodies, till it has taken that Form or Figure which it maintains to the End of its Life: ſuch *Animals* are termed *Viviparous*. One might make yet ſeveral remarkable Diſtinctions among thoſe created Bodies which are *Oviparous*. The *Eggs* of *Birds* hatch at once into Bodies properly formed, agreeing with the Figures of their own Race. The *Spawn* or *Eggs* of *Frogs* have ſeveral different Changes before they gain their compleat Figure. The *Eggs* of *Butterflies* and *Moths* hatch at firſt into *Caterpillars*, and from this

Shape change into a *Chryſalis*, and from that again into the *Fly*. The *Seed* or *Eggs* of *Plants* hatch at once into a *Plant*; tho' indeed we may obſerve in ſome of them a conſiderable Difference between the *Seed Leaves*, and thoſe which they are adorn'd with when they ſhoot out their *Stalks* and *Branches*. The *Ear Leaves*, or thoſe next the *Root*, as I have already hinted, doing the ſame Office to the *Virgin Plant*, as the *Breaſts* or *Dugs* of the Mother *Animals* do to their Young, *i. e.* to furniſh them with their firſt Nouriſhment, and ſupport them till they can find a ſuitable Food in the Earth; and this is ſo certain, that if we take away the *Ear Leaves* of a *Plant*, ſoon after it has made its firſt Shoot from the *Seed*, the *Plant* will die in a ſhort time. The *Eggs* or *Spawn* of *Fiſh* hatch and become *Fiſh* at once; but in ſome of this Race (I am told) the *Eggs* or *Spawn* are not impregnated till after they are excluded from the Bodies of the *Females*.

It is obſerv'd by ſome great Men, that the *Animalcules* in the *Seminal Liquor* will live ſeveral Days after the Death of their *Male* Parent; and even ſome have gone ſo far, as to affirm, that theſe *Animalcules* will remain alive in the *Matrix* of the *Female* two or three Months after the *Liquor* has been lodged there, altho' they had not the Advantage of the proper *Nidus* or *Egg-Neſt* to afford them any help, and then conclude that thoſe Parts may be impregnated by ſuch *Animalcules* two or three Months after Copulation, which (as they ſay) is the Reaſon that ſome *Females* are longer between the time of Coupling with the *Male*, and the bringing forth their Young, than others; ſo that, according to their Syſtem, ſome of the Human Race may bring forth eleven or twelve Months after they have been with a *Male*.

To confirm the Syſtem of Generation by the *Animalcules* in the *Male Liquor*, we may obſerve, that in ſuch *Animals* as are not yet arriv'd at their higheſt Perfection, the *Male Liquor* in them is wanting of *Animalcules*. If we examine the *Teſticules* of ſmall *Chicken*, or any young *Bird* or *Fowl*, ſoon after hatching, or any *Animal* newly brought into the World, the *Male Liquor* has not any *Animalcules* in it, no more than can be found in the *Seminal Veſſels* of an extream old Man, or any Creature that has been worn by Diſtempers; but we never fail to find them in vaſt Numbers in ſuch Bodies as are full grown, and in a vigorous State of Health. But I ſhall conclude this Account of Generation, with obſerving only, that the *Egg* of the *Female*, before Impregnation, ſeems to poſſeſs a Degree of Growth or Life, ſomewhat like that in *Minerals*; when the ſame *Egg* is impregnated, it then poſſeſſes a kind of *Vegetative* Growth; and takes upon it the *Animal* Life and Growth as ſoon as it quickens, at which time it only begins to enjoy the Power of *Senſation*.

We come now to obſerve ſuch of the four-footed Race as are *Amphibious*, or live as well upon the Land as in the Waters: Such is the *Hypopotamus*, or *River-Horſe*, which is found about the River *Nile*, which Creature is as big as a large *Bull*. There is now one of them well preſerved at the Phyſick Garden at *Leyden*. After this the *Otter* and *Beaver* may be obſerved, as *Animals* which inhabit Pools, Ponds, and Rivers of little reſort, whoſe Prey is chiefly upon *Fiſh*. And next theſe the *Seal* or *Sea-Calf* may well enough be placed, as it much more relates to *Quadrupedes* than the *Fiſh* kind: It is *Viviparous*, and thinly cloathed with *Hair*, and likewiſe ſuckles its Young; but its *Tail* and Finn-like *Feet* declare it to inhabit the Waters, for the moſt part, being rather contriv'd for ſwimming than for walking or moving upon the Land.

Having now conſider'd the principal Parts of *Quadrupedes*, and given ſome Account of their Uſes, I am led naturally to treat of ſuch Creatures with four *Legs* as are partly *Animal*, partly *Inſectal*, ſuch as *Frogs* and *Toads*.

Plate XIV.

Fig. I.

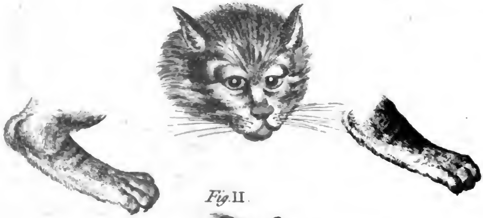


Fig. II.

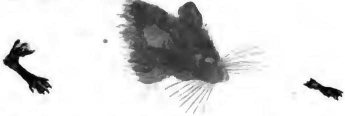
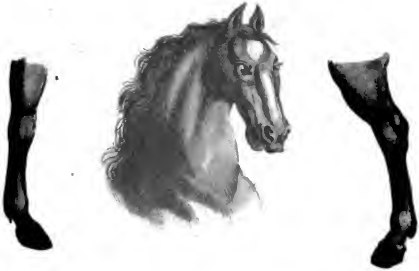


Fig. III.



J. Cole sculp.

Plate : XV

Fig. I

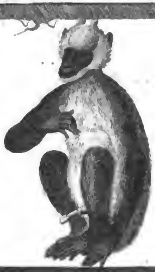


Fig. II

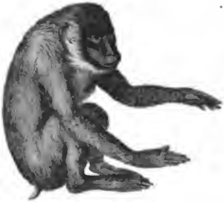
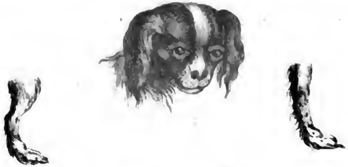


Fig. III.



[illegible] sculp.

I ſuppoſe it may be wonder'd at, that hitherto I have not mention'd Mankind, who is ſo remarkable a Creature, and Lord of all the reſt; I confeſs, was I to have placed him where the Parts of his Body would moſt agree with thoſe of the created Bodies mention'd in this Treatiſe, I muſt have ſet him in the middle of this Chapter; but I ſuppoſe my Reader will excuſe me, if I ſhew him ſo much regard, that I rather ſpeak of him in the ſumming up of my Scale, than let him be encompaſs'd with wild Beaſts.

Explanation of the Plates relating to this Chapter.

PLATE XIV.

Fig. I. *The* Head *and* Legs *of a* Cat, *ſetting forth the Diſpoſition of thoſe Parts in moſt Beaſts of Prey.*

Fig. II. *The* Head *and* Legs *of a* Mouſe, *ſhewing the Difference between the* Claw-footed *and the* Talon-footed Beaſts, *as alſo the Diſpoſition of the Joints to help them in their Motion.*

Fig. III. *The* Head *and* Legs *of a* Horſe, *in which we may obſerve the Strength and Manner of its Jointing, and the whole* Hoofs *of a* Horny *Subſtance, diſpoſed as well for its Defence as for hard Labour.*

PLATE XV.

Fig. I. *The* Man-Tiger; *from* Africa.

Fig. II. *A* Monkey *of an extraordinary Kind; from Mr.* Randal's *in* Channel-Row.

Fig. III. *The* Head *and* Legs *of a* Spaniel, *being a Continuation of the* Claw-footed *Kind.*

PLATE

PLATE XVI.

Fig. I. *The* Head *and* Legs *of a* Hog, *being one of thoſe* Cloven-footed Animals, *without* Horns.

Fig. II. *The* Head *and* Legs *of a* Buck, *or a* Cloven-footed Animal, *of the* Annual Horn'd *Race.*

Fig. III. *The* Head *and* Legs *of a* Stag, *or the largeſt Kind of the* Cloven-footed Annual Horn'd *Race.*

PLATE XVII.

Fig. I. *The* Elephant, *brought from* Fort St. George *in the* Eaſt Indies, *whoſe* Tusks *are not yet cut or budded. As the* Tusks *of this Creature always grow in the* Upper-Jaw, *I ſuppoſe them rather* Horns *than* Teeth.

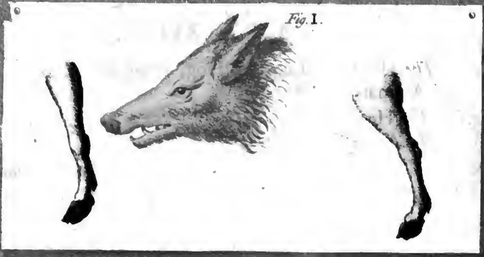
Fig. II. *The* Head *and* Legs *of a* Goat, *or one of that Race with irregular twiſted* Horns *which are* Perennial.

Fig. III. *The* Head *and* Legs *of a* Sheep, *being one of the Race which produces curl'd twiſted* Horns.

Fig. IV. *The* Head *and* Legs *of a* Bull, *ſerving as an Example of the ſmooth* Horn'd *Tribe, whoſe* Horns *are* Perennial.

CHAP.

Plate XVI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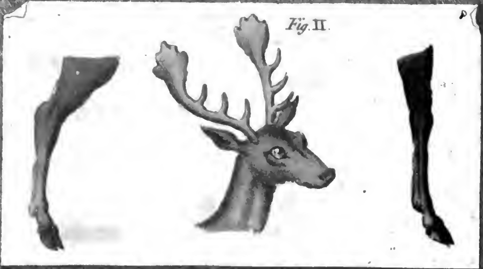
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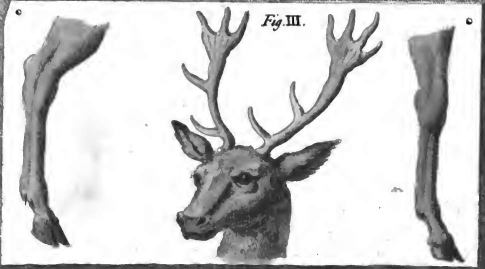


Fig. III.

J. Cole sculp.

Plate XVII

Fig. I.

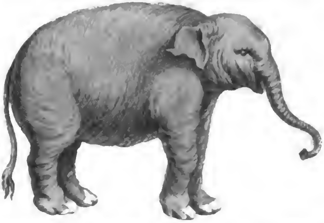


Fig. II.

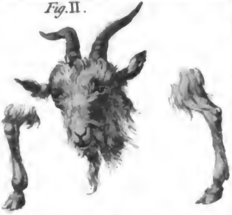


Fig. III.

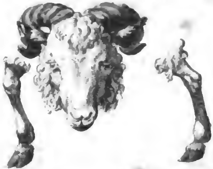
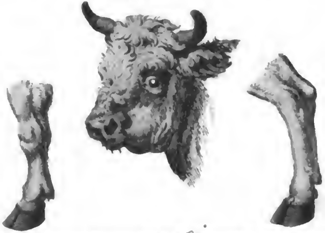


Fig. IV.



J. Cole sculp

CHAP. X.

Of FROGS, TOADS, *and ſuch Creatures as are partly Animal and partly Inſectal.*

THE Creatures which are the Subject of this Chapter, are in ſome reſpects like the *Animals* treated of in the preceding Pages, and in other things are analogous to *Inſects:* They agree with the former in the number of their *Legs*, and the Method of their Coupling, only that in theſe the *Male* and *Female* are join'd for three Days, and the *Quadrupedes* already mention'd are not ſo long in that Act. Their fleſhy Parts are like thoſe in *Animals* of the four-footed Kind; but the many different Changes they have between the *Spawn* and the *perfect Frog*, is as remarkable as thoſe in the *Inſect* Race. Again, the *Frogs* ſleep, or are laid up in the Winter, as are the longer-lived *Inſects:* And their different Degrees of Life, within and without the Waters, make them ſomewhat analogous to *Gnats*, which live their firſt Stage of Life in the Waters, and the Remainder of their time in another Element.

The Difference between the *Frogs* and *Toads* in *England* is very remarkable, tho' ſome will hardly allow any, which I ſuppoſe proceeds from their want of Obſervation. They will have it that *Toads* are no more than *Male Frogs*, or that all *Frogs* that have black Backs are thoſe which we ought to call *Toads*; but I hope to ſet them right in the following Accounts of both.

The *Skin* of our *Engliſh Frogs* is ſmooth, their Motion nimble and agile: one ſort has the *Skin* of the *Back* of a dark Colour, and the other is yellow, mark'd with Specks here and there. The *Skin* of the *Toad* is rough and knotted, and its Motion is heavy, dull, and crawling: the *hind Feet* of the *Frog* are webb'd like thoſe of a *Gooſe*; and *Frog Spawn* is large as *Peaſe*, and is brought forth in a clump. The *Feet* of the *Toad* are not webb'd, and its *Spawn* is ſmall, and chain'd together. *Toads* will live in damp ſhady Places without ever entring the Waters; but *Frogs* cannot live without them. The Voice of the *Toad* is much coarſer than that of the *Frog*, and its Method of Life in many things different. A *Toad* will live a long time in the Air-Pump, after the Air is exhauſted; but a *Frog* will die in leſs than half the time. We have Inſtances of *Toads* that have been taken out alive from the middle of large Blocks of hard Stone. And I was once Eye-witneſs of a *Toad* which was ſaw'd out of the Center or Heart of the Trunk of a large *Oak*; but I have never yet heard of any *Frog* that was thus encloſed. It is reported that an angry *Toad* will piſs a ſort of venomous Liquor, which is injurious to any living Creature it touches, but eſpecially to Mankind. I had once one of them, which ſpouted ſome of this *Liquor* in my Eye, but I received no Damage from it, perhaps becauſe I immediately waſh'd it with fair Water at a Pump; but we do not find that *Frogs* ever produce a *Liquor* of this kind. 'Tis common in *France*, and ſome other Countries in *Europe*, to eat the *hinder Legs* of *Frogs* as a great Dainty; but I have not yet heard of any that have been bold enough among the *Europeans* to feed upon *Toads*, unleſs ſome few Mountebanks, who have done it to ſhew the Excellency of their Antidotes. I have often heard that the People of *China* ſell *Toads* in the Markets, of a very large Size, and hold them to be great Dainties; but I ſuppoſe they are rather *Frogs* than *Toads*, and have only been thought to be of the latter Kind, for want of Knowledge enough of the material Differences which we find in one and the other. Upon the *Alps* there is a kind of *Toad* about four times larger than our *Engliſh Toad*. And I have ſeen in the Cabinets of Mr. *Seba* and Dr. *Ruyſh* of *Amſterdam*, many Kinds of them well preſerv'd, and great Variety of *Frogs* with long *Tails*, curl'd *Ears*,

Ears, and their *Backs* mark'd with various Figures. In the firſt of theſe Cabinets there is a remarkable Set of *Frogs*, which, from the Form of the common *Frog*, differ in the Frame of their Parts gradually, till the laſt is of the Figure of a *Fiſh*, which Gradation of *Frogs* may ſerve to adorn the next Work I ſhall write of this Nature. It will be ſufficient for me at preſent to give my Reader an Account of their Generation, and of their gradual Alterations from the *Spawn*, till they become *perfect Frogs*, as it was obſerved by that accurate Anatomiſt, Dr. *Douglas*, F. R. S. to whom I am likewiſe obliged for the following Account, *viz.*

Of the curious Structure and Conſtitution of the Genital Parts in a Female Frog, *full of Eggs.*

OF all the conſtituent Parts of this deſpicable, loathſome, little Animal, there's none more artfully contrived, nor ſo curiouſly framed, as thoſe that ſerve for propagating the *Species* in both Sexes, but eſpecially in the *Female*; and from the great Analogy and Likeneſs that's between theſe in this little *Animal*, and thoſe in Women, we may draw a moſt convincing Argument to ſtrengthen and enforce their Opinion, who maintain the Syſtem of the *Eggs*.

Two *Ovaria's*, two *Oviductus's*, and two *Uterus's*, are the Parts to be deſcribed.

The *Ovaria* are two large *veſicular Bags*, formed of a thick glandulous *Membrane*, with a *Cavity* within very apparent, if you diſtend them with Wind.

Each *Ovarium* is placed about the middle of the *Abdomen*, laterally on each ſide the *Spine*, being faſtned by *Blood-Veſſels* and *fibrous* Connexions to the *Meſentery*, about the upper part of each *Kidney*.

Their Bigneſs varies according to the Number and Magnitude of the *Eggs* they contain; for juſt after they have drop'd off they look flacid, being contracted into a narrow Compaſs, feel ſoft and ſlimy, and appear of a yellowiſh Colour, having a

R number

number of little black Specks or Points here and there intermix'd; but when the *Eggs* are come to their Maturity and full Ripeneſs they are very large, and look of a black Colour ſpotted with white, very much diſtending the *Belly*.

The *Tubes* or *Oviducts* are two long *Channels* or *Pipes* lying on the Sides of the *Belly*, between the *Lungs* and the *Uteri*. In their natural Situation they are rolled up and faſtned together by a *Membrane*, as by a *Meſentery*, making ſeveral anfractuous *Gyri*, or winding Circumvolutions, not unlike the ſmall Guts in little *Birds*.

Theſe, as well as the *Ovaria's*, differ in Bigneſs and Colour, according to the Seaſons of the Year, and different times of Geſtation; for juſt after all the *Ovula* are paſſed, they are ſlender, and very ſmall, of a yellowiſh Colour: However, if they be thrown into the Water, they ſwell and become ſomething bigger: But juſt before the *Ovula* are looſened, they are as big as a *Gooſe-quill*, of a whitiſh Colour; and if they are then thrown into Water, they will, in the Space of one Night, ſwell ſix times bigger, and in a little time after they will diſſolve into a kind of Mucilage or Gelly. The Inſide of theſe *Tubes* are covered with a thick, ſlimy, glutinous Matter, which beſmears the *Ovula* in their Paſſage, and afterwards ſerves for a *Nidus*, if not for Nouriſhment alſo, to the little *Animals* or *Tadpoles*, all whoſe perfect *Lineaments* are wrapped up and contained in theſe *Ovula*, as it were, in Miniature; ſo that when all that *roapy*, *viſcid gluten*, ſeparated there by the *Glands*, is rubbed off, they muſt needs leſſen in their Bulk.

The Beginning of each *Tube* is upon the *Septum Tranſverſum*, juſt under the *Lobes* of the *Lungs* near the *Heart*; it opens by a pretty large *Orifice*, and its Subſtance, for about half an Inch, is membranous, with ſome *Striæ* or *Ridges* appearing upon it.

The *Uterus* is made up of a very thin and tranſparent *Membrane*, being divided into two diſtinct *Cavities* by a *Septum*, and each of them opens by a particular *Orifice* into the *Rectum*

Inteſtinum, which paſſing over this *Bag*, braces it down, and makes it bulge out on each ſide.

When the *Ovula* are come to their full Maturity, they are detatched from the *Ovarium*, and being looſened, they fall into the *Cavity* of the *Abdomen*, where they float about for ſome time, till by the Motion of the *Sterum* and abdominal *Muſcles*, being much aſſiſted by the conſtant and long Compreſſion of the *Male Frog*, (which, according to the Obſervation of the curious *Swammerdame*, rides upon the *Back* of the *Female* for forty Days compleat, cloſely embracing, and claſping round its Body with its *Fore-legs* under hers, joining its *Claws* upon the *Sterum*) being received into its gaping *Orifice*, the ſame Motion does forward its Progreſſion to the *Uterus*; and it's not improbable, but the *Tube* it ſelf may have ſomething of a vermicular Motion, which may be of uſe in propelling the ſame; after they have been ſometime in the *Uterus* they are diſcharged, *ſtatis temporibus per Annum*; the *Male* being ready, at that very Inſtant, to beſprinkle them with his *Semen*, in order to impregnate and render them fruitful.

We find in the common *Female Frog*, that the *Ovaries* ſpread themſelves almoſt over its whole *Back*, and even reach within a very little of the *Head*, which I believe is common to all of the *Frog* kind, altho' they do not always produce their Young after the ſame manner. The curious *Surinam Frog*, which Madam *Mariana* of *Amſterdam* has publiſhed in her *Hiſtory of Surinam Inſects*, brings its young ones perfectly fram'd into the World, after they are hatch'd in certain Cells, within the *Skin* of the *Back*. Sir *Hans Sloane* has one of theſe Creatures in his Cabinet; and we may find others of the ſame in the Collections of Mr. *Vincent* at *Harlem*, Dr. *Ruyſh* and Mr. *Seba* of *Amſterdam*, and at the Phyſick Garden in the ſame City, in which Cabinets of Rarities I have obſerved this *Frog* in three different States; firſt, the *Pores* of the *Back Skin* were all cloſed, excepting three or four, which began to be forced open by the *Eggs* lodged in Cells below them. The ſecond had all the *Pores* in the *Skin* of the *Back* ſo much opened, that I could plainly diſcern the Points of the *Eggs* within them; and the third had young ones perfectly formed in all thoſe Cells in the *Back*, as it appears in the Figure of the twenty ſecond Plate. I chuſe rather to rank it with *Frogs*, as it is Web-footed, and an Inhabitant of the Waters, than place it with the *Toad* Race.

From what we have here ſaid, it appears that *Frogs* and *Toads* partake of many Qualities obſervable in *Inſects*, though not in every reſpect; but as they agree with them in ſome Particulars, I ſhall next conſider thoſe Inſectal Bodies, which may be ſtiled irregular *Inſects*.

Explanation of the Figures relating to this Chapter.

PLATE XX. A.

In this Figure I. A. *the Parts of Generation in a* Female Engliſh Frog *are delineated, being firſt taken out of the Body, and then expanded.*

A: A: *The* Tuba Uterina *or* Oviduct *ſeparated from its Connections, and drawn out to its full length.*

1. *Its upper* Orifice.
2. *Its opening into the* Uterus.
3. *Some of the* Ovula *ſticking in its* Cavity.

B. *The* Oviduct *of the other Side.*

4. *Part of the membranous* Meſentery *left on.*
5. *The Circumvolutions and Windings of the* Tube.

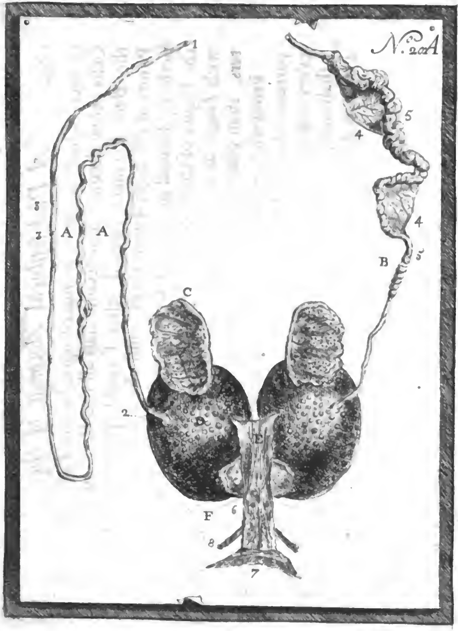
C. *The empty* Ovarium.

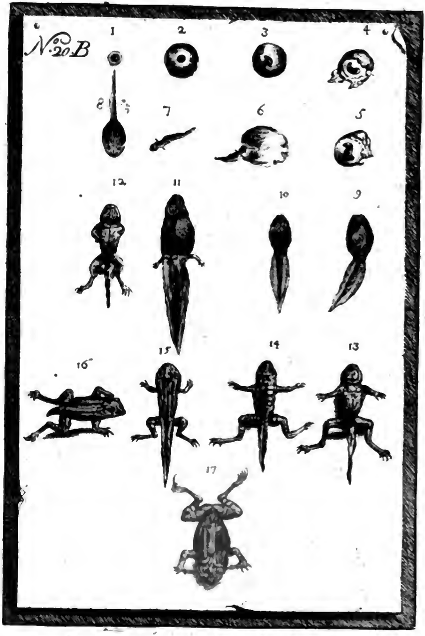
D. *The* Uterus *diſtended with* Eggs *or* Spawn, *appearing of a blackiſh Colour at the Sides, but whiter in the Middle.*

E. *The* Inteſtinum Rectum *cut open, and turned back on the Sides of the* Uteri.

6. *The ſmall* Orifice *or Opening, by which the* Ovula *paſs from the* Uterus, tempore partûs.

7. *The*


N.° 20 A


N.° 20 B

7. *The* Sphincter Ani.
8. *The* Levator *of the ſame.*
9. *The* Veſica Urinaria *divided and laid back.*

PLATE XX. B.

In this Plate are repreſented, in Seventeen Figures, drawn from the Life, the ſlow and gradual Epigeneſis Ranarum; *that is, all the remarkable Changes, and the ſeveral Gradations that are obſerved in the Growth of a* Frog, *from the* Ovum, *or* Spawn, *to a compleat and perfect* Animal.

N° 1. *Exhibits an* Ovum *juſt ſpawned, and taken out from the Heap, or as it appears when it drops from the* Uterus *in a Cluſter, having a round black* Speck, *or* punctum nigricans, *in the Middle, which is the firſt Rudiments of the* Tadpole: *The Outſide of this* Spot *is of a whitiſh Colour.*

N° 2. *This Number ſhews the* Ovum, *after it has lain ſome Days in Water, ſurrounded with its gluten, or a viſcid, glewy Subſtance, commonly called* Sperma Ranarum, *or* Frogs Spawn.

N° 3. *Here the black* Speck *has changed its round Figure into a longiſh one, being curved, and ſmaller at one end than the other.*

N° 4. *In this the* Gyrinus, *or little* Animal *is grown bigger, and the* Pellicula, *or thin* Membrane, *that contains the viſcid Subſtance, appears ragged and tore, as if Cobwebs hung to it.*

N° 5. *The glutinous Humour, that in the preceding Figure was ſmooth and even, appears in this, to be hollow like a ſtoned* Raiſin.

N° 6. *This Number ſhews the* Gyrinus (*which now has put on the Shape of a* Vermiculus, *or little* Worm, *called properly a* Tadpole, *and by our Country People a* Bull-head) *ſticking by its Mouth to the glutinous, alimentary Subſtance. After the* Vermiculus *had undergone this Change, I firſt obſerved it to move its* Tail, *and become a living* Animal.

N° 7. *Here we have exhibited the little* Tadpole *detatched and freed from the viſcid Matter, that not only ſerved for its Nouriſhment, being received in at its Mouth, for it had nothing analogous to* *the* Vaſa Umbilicalia, *to convey it that way, but alſo for a Bed to lye on while weak and tender: here are likewiſe obſervable, a* Head, Body *and* Tail, *with two little ſharp Points near its* Head.

N° 8. *This Figure repreſents our* Gyrinus *much bigger, with a thicker* Head *and* Body, *and a long narrow* Tail; *and being touched, was able to move it ſelf in the Water very nimbly and quick, like a ſmall* Eel; *and from this frequent whirling round in the Water, this little Creature is named as above.*

N° 9. *In this* Tadpole *you may perceive ſome of the Windings and Circumvolutions of the* Guts, *through the thin tranſparent* Skin, *and other Integuments of the* Belly.

N° 10. *By this Figure the ſame* Animal *is repreſented in a different View, in which it appears to be leſs than the former.*

N° 11. *Here we may with Pleaſure obſerve the two* hinder Legs *ſenſibly budding out: the* Tail, *which, like a* Rudder, *ſerves to ſteer or move its little* Body, *is very large; the Sides or Edges of it are thin and tranſparent; and down its Middle there runs a thickiſh hard Subſtance of a browniſh Colour.*

N° 12. *In this View we ſee the* hind Feet *longer, one of the* Fore-legs *half out, and the other juſt beginning to protuberate thro' the* Skin.

N° 13, 14, 15. *Do all repreſent the* Tadpole, *gradually grown bigger.*

N° 16. *Here the* Gyrinus, *or* Tadpole, *is now undergoing its laſt Change; and as ſoon as the* Tail, *which is now almoſt wore off to a Stump, is quite loſt, it aſſumes the Denomination of a perfect* Frog, *which*
N° 17. *Repreſenteth to our Eye.*

PLATE XXI.

Fig. I. *The* Frog *fully perfected.*
Fig. II. *The common* Engliſh Toad.

PLATE XXII.

Fig. I. *The* Surinam Frog, *ſhewing the Manner of its bringing its young ones, perfectly form'd, out of the* Pores, *in the* Skin *of its Back.*

Plate XXI

Fig. I.

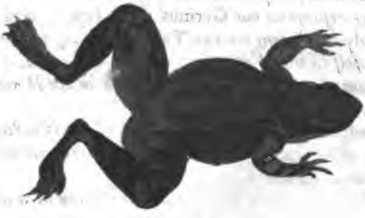


Fig. II.

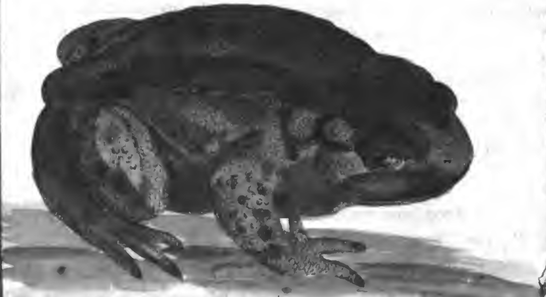
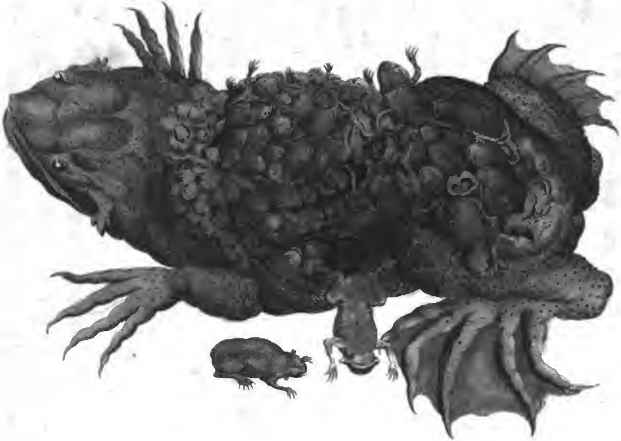


Plate XXII.

Fig. I.



J. Cole Sculp.

CHAP. XI.

Of SNAILS, EARTH-WORMS, CENTIPEDES, MILLIPEDES, SPIDERS, *and Inſects without Wings, which may be ſtiled Irregular Inſects.*

THE Contents of this Chapter have very ſurpriſing Particulars, differing almoſt in every thing from all other created Bodies. The *Snails*, which I ſhall firſt treat of, have indeed ſome little Affinity to *Animals*, ſuch as the hatching of their young ones at once perfectly form'd; they are *Oviperous*, but the manner of their Coupling is extraordinary: Every ſingle *Snail* poſſeſſes the generative Parts of both Sexes, and makes uſe of them equally when they couple: The Situation of theſe Parts is on the left ſide of the Head; but are only to be diſcovered when they are generating, which is about the middle of *May*; they remain in Copulation about twelve Hours, and are then hardly to be ſeparated without wounding their Parts: about three Weeks after this Act is over, they make their way into the Earth, and lay their *Eggs* in Knots of about thirty in number, near four Inches deep; for this they commonly make choice of a moiſt, ſhady Place, in which Station their *Eggs* are hatch'd in about a Month, and the young *Snails* then appear above Ground. The manner of their meeting to couple is well worth obſerving; in *dewy* Evenings, or after a Shower of Rain, they crawl upon the Graſs in a circular manner, making ſeveral Rounds, till they come near enough to one another to hit their Deſign; I have obſerved them ſometimes make above twenty Turns before they could join. The *Dew Snails*, and what the Gardeners call *Slugs*, have all of them the ſame Mode of Generating as we obſerve in the *Shell Snail*, which is of ſeveral Kinds, with regard to the Conſiſtency of their Fleſh, and Colour and Variegations of their Shells; but upon their firſt hatching they are ſo very tender, that the Weight of a few Grains would cruſh them out of Form; and it is hard at that time to make any Diſtinction between the different Kinds. Their Fleſh is of a ſpungey Texture, and the Juices which afford it its Nouriſhment are viſcous which I ſuppoſe may be one Reaſon why the Motion of *Snails* is ſo very ſlow, that kind of Juice being of too thick a Subſtance to circulate quickly. I have been informed, that the moſt intenſe Cold, which can be produced, either by Nature or Art, cannot freeze the Juice of *Snails*; but I think all *viſcous* Matter is hard to be congeal'd; for I do not find that *Bird-lime*, if it is in any conſiderable Body, will freeze, if it be expoſed to the coldeſt Air, no more than the *Berries* of the *Miſletoe* or *Viſcum*, whoſe Seaſon of Ripeneſs is in the coldeſt time of the Winter; but other *Seeds*, whoſe Juices are more *aqueous*, are ſpoilt by a little Froſt. The Food of all this Race is tender *Leaves*, and young *Sprouts* of *Plants*, which they devour, by means of a Tooth-like Body growing in their upper Jaw, with which they rather ſcrape the *Leaves* to pieces than maſcerate them; for there is no ſign of any Teeth in their lower Jaw. In the twenty third Plate I have given a Figure of the *Teeth*, but eſpecially of the generative Parts, as they appear at the Time of their Coupling; both done with a *Microſcope*.

The better to diſcover the Degree of Life in theſe Creatures, whoſe Circulation of Juices ſeem ſlow enough to come nearer to a State of Stagnation, than the Motion of Juices in other Animals, I have endeavour'd to find out the Situation of the Heart, and to compare its Motion with the *Beats* of a *Pendulum*. The firſt Subject I met with, which gave me the View of this Part, was a ſmall *Snail* juſt hatch'd, whoſe *Body* and *Shell* were ſo tranſparent, that I could diſcern its *Beats* to be diſtant about three Seconds; but as I ſuppoſed the Juices in this were much more fluid than in the older *Snails*, I had recourſe to ſome of the largeſt I could find; but their *Shells* not being tranſparent, I was obliged to take them off as well as I could, without wounding the *Snails*; and then on their left Sides I plainly diſcover'd the *Beats* of the Heart to be about five Seconds of time diſtant from one another, and three Hours afterwards about ſeven Seconds, tho' ſome of them were then ſtrong enough to begin the renewing of their *Shells*, which they effect, by flinging out a large Quantity of *viſcous* Matter thro' the Pores of that part of the Body which had been encaſed before. The Motion of theſe Creatures is perform'd by repeated Undulations of their fleſhy Parts, without the help of any *Feet* that I can diſcover; this undulating Motion preſſes a *viſcous* Matter out of their Pores, which ſerves to give them hold of any thing they crawl upon, and helps them in their creeping up the Sides of *Walls* or *Trees*, and even when they reverſe their Bodies, and creep upon *Ceilings* with their *Shell* downwards. But it is obſervable, that a *Snail* ſeldom has any Motion but when it is in ſearch of Food, or is about Generating, and then it is only when the Ground is wet, and it has Opportunity of ſupplying its loſt Juices by freſh Food. I have remark'd, that when a *Snail* is obliged to paſs over a dry duſty Place, it loſes ſo much of its *viſcous* Juice, that it can hardly recover it again.

The next I am to take notice of is the *Earth-Worm*, whoſe Shape is long and round, and their Bodies compoſed of ſeveral *Annuli*, jointed in one another, upon ſome of which ſome curious Men have obſerv'd little *Feet* or *Aſperities*, with which it is ſuppoſed they take hold of the Ground as they creep along. This *reptile* Motion, as Dr. *Tyſon* obſerves, may be explain'd by Wire wound on a *Cylinder*, which when ſlipt off, and one End extended and held faſt, will bring the other nearer it. In this manner the *Earth-Worm* having ſhot out or extended its Body, (by a ſort of wreathing) it takes hold of the Ground with its ſmall *Feet*, and ſo contracts the hinder part of its Body. Theſe Creatures cannot bear Heat no more than the *Snails*, and ſeldom are ſeen out of the Earth but when they are diſturb'd, or when a Dewy Evening or wet Weather invites them to couple, and even then they do not entirely quit their Holes, but extend their Bodies as far as they conveniently can, to reach one another, and couple much after the ſame manner as *Snails*, *i. e.* by performing each of them the *Male* and *Female* Duty. But I have not yet been nice enough in this Enquiry, to determine whether they are *Oviparous* or *Viviparous*.

After theſe we may next take notice of *Jointed-Worms* with many *Feet*, which are call'd *Centipedes* and *Millipedes*: theſe have always their Habitation in ſhady moiſt Places, chiefly in rotted Wood, and under Logs, or amongſt Rubbiſh. Our *Engliſh* Kinds of *Centipedes* are about two Inches long, conſiſting of about thirty *Joints*, every one of which has two *Legs*, as ſmall as *Hairs*, ſo that they have in all about ſixty *Legs*, which they move alternately; and yet for all this mighty Number are but ſlow in their Motion, compared with other *Inſects*. In the *Weſt Indies* there is a kind of *Centipes* about eight Inches long, when it is full grown, whoſe Figure I have taken from one now in the Royal Society; but how theſe Creatures are produced, I have not yet had an Opportunity of obſerving, no more than the Generation of thoſe Creatures call'd *Millipedes* or *Wood-lice*, which, tho' they bear that Name, have not above half the number of *Legs* that we obſerve in the former: their Bodies are cover'd with *Jointed Scaley* Subſtances, which give them ſomething of the Figure of an *Armadillo*; but I never obſerve the Parts of theſe to alter as thoſe do among the regular *Inſects*, which I ſhall treat of in the next Chapter.

I come now to mention the *Spiders*, another Tribe of *Inſects* which is very numerous, there being above a hundred and forty different Kinds of them in *England* only, as the curious Mr. *Dandridge* of *Moorfields* has obſerv'd and delineated. 'Tis obſervable in this Race, that they are all wanting of that part which we might properly call the *Head.* As the Bodies of regular *Inſects* are commonly divided into three Parts, (*viz.*) the *Head*, the *Stomach*, and the *Tail:* Theſe for the moſt part have their Bodies divided only into two, reſembling as it were the Bodies of *Bees* or *Waſps* without their *Heads*; but about the place where the *Head* ſhould be ſet upon the Bodies of *Bees* or *Waſps*, i. e. the Paſſage immediately into the *Stomach*, we obſerve two *Feelers* or *Antennæ*, with Tooth-like *Jaws*, for the pinching and maſcerating their Food. Upon the Upper-ſide of the ſame part we diſcover their Eyes, which are commonly eight in number, and differently placed, as the *Spiders* are of different Make. The *Long Legs*, which is of this Tribe, has its Body undivided, and no ſign of any *Head* no more than the reſt. Mr. *Dandridge* obſerves that this Kind has but two *Eyes*; and I have not remark'd that it is fond of Motion, but remains conſtantly in the ſame place where it is hatch'd, unleſs it be provok'd or diſturbed. 'Tis remarkable that all our *Engliſh Spiders* have eight *Legs*; but thoſe which we receive from the *Weſt Indies* have ten. Among *Spiders* we may further obſerve, that as they are of different Claſſes, they have different Modes of Motion, and of catching their Prey; one of the ſmaller ſort jumps from place to place; another Kind, after running about a Yard, makes a full ſtop, and then running about the ſame Length ſtops again; others are ſo very quick, and continued in their Motion, that they will run about ten Yards in two Seconds of time. Again, we may remark, that ſuch Kinds as have *Webs* have different Manners of compoſing them; ſome of them are of the Figure of a Tunnel-Net, diſpoſed for catching all kind of *Flies* that come into it, the *Spider* himſelf lying out of ſight: Theſe Kinds are commonly found in Houſes, and are more voracious than any of the other Kinds.

Another ſort makes his *Web* almoſt of the Figure of a Caſting Net, and places himſelf always in the Center. The Regularity and artful Contrivance in its compoſing this *Web*, together with its ſurpiſing manner of paſſing from *Bough* to *Bough*, without any help but the Air to lay its *Foundation Threads*, is well worth our while to obſerve, and perhaps may have given ſome Aſſiſtance to the Inventors of Weaving or Knitting.

We have many Accounts of the Flight or Sailing of *Spiders* in the Air, by means of their *Webs* or *Thread*; but I have not yet had an Opportunity of obſerving it as I would do. I have meaſured the *Webs* of ſome of the larger Kind of *Spiders* in *England*, in one of which there was above forty eight Yards of *Thread*; another contained about forty ſix. It appears by Mr. *Dandridge*'s Collection that we have but nine different Claſſes of *Engliſh Spiders*; one of each Claſs is engraved in the twenty fourth Plate: in the ſame I have alſo given a Cut of the *Tarantala*, taken from that in the Royal Society, which *Spider* is ſaid to be very venomous, and has given Riſe to many Relations, which I account fabulous; but there is no Creature of this Race which I eſteem more extraordinary than the large *Weſt Indian Spider*, which meaſures ſometimes above five Inches over, as may be ſeen in Dr. *Ruyſh*'s Cabinet at *Amſterdam*; it has ten *Legs*, covered with long brown *Hair*, which gives it a very frightful Aſpect. It is ſaid that the *Web* of this *Spider* is ſtrong enough to catch the *humming Birds* which it preys upon.

Among the *Inſects* of this Chapter I cannot help mentioning the *Ant* or *Piſmire*, whoſe Induſtry and Cunning may afford us ſufficient Matter for Obſervation. 'Tis one of thoſe *Inſects* which either ſleeps the Winter, or is laid up at that time; but I the rather believe the latter, becauſe of its Care in providing and laying up Food. There are ſeveral ſorts of *Ants*, ſome of which are larger than our common Houſe *Flies*; theſe are call'd *Horſe-Ants*, and are ſeldom fewer than five or ſix thouſand together:

their Habitation is commonly under the *Roots* of great *Trees*, where they may beſt live undiſturbed. They feed commonly upon dead *Inſects*, or *Carrion*, like the common ſmall Kind, and ſeem to agree with them in every reſpect but their Size. If we open one of their *Neſts*, we diſcover Galleries and Paſſages in ſeveral Ranges one above another; but yet all ſo diſpoſed as to have a free Communication one with another. 'Tis obſervable among theſe Creatures, that if any of their own *Brood* happen to be kill'd, they immediately remove him from their Habitation; and if they meet with any dead *Inſect*, or other proper Food in the Courſe of their Travels, they find means to bring it home, although it be very diſtant from their Apartments. There is no better way to prepare the *Skeletons* of *Mice*, and other ſmall *Animals*, than by fixing thoſe Creatures in a right Poſture in a little Box with Holes in it, and burying it among theſe *Ants*, which, in a few Days, will clear the Bones of all the Fleſh; ſo that they are able to perform what ſcarcely the fineſt Knife in the World can execute. This ſort of *Ant*, as well as the ſmalleſt Kind, is hatch'd from an *Egg* about *June* or *July*. I have obſerved, that in the Mornings, as ſoon as the Sun begins to have ſome Influence, the whole Colony is employed in bringing up their *Eggs* to the Surface of their Hill, that they may be within Reach of the Sun's Warmth; but as ſoon as the Sun begins to decline, they renew their Labour, and return their *Eggs* to the loweſt Caverns to lie ſafe from the Evening Cold; and this they do every Day when the Weather will permit, till their young ones are hatch'd. I am here at a Loſs, to know whether thoſe which are winged among them, at that time, are the Young or the Old; but it is certain, that thoſe which have *Wings* leave the reſt in a few Days, perhaps to ſeek ſome other Habitation. It is remarkable, that the common ſmall *Ant* will often frequent Houſes in ſearch of their Food; and if they are lucky enough to find out Sugar or Sweet-meats, their whole Tribe are ſoon apprized of it, and follow them to the place. A noble Lord gave me a remarkable Inſtance of it: A *Neſt* of theſe Creatures in his Garden diſcovered a Cloſet of Confections many Yards within the Houſe, and had a conſtant Recourſe to it, by a certain Road which they traced out through two Rooms, which they obſerved ſo exactly, that they hardly varied an Inch from it; and what is moſt remarkable, theſe Creatures continued for ſome Days the ſame Route, notwithſtanding the ſweeping and cleaning of the Rooms, they paſt through, till the whole *Neſt* was deſtroyed.

I have obſerved one ſort of *Ant* which lays its *Egg* in the Back of the *Oak Leaf*, and raiſes the Bliſters in thoſe *Leaves*, which we call the *Oak-Berries*; thoſe *Berries* are round, and about the Bigneſs and Conſiſtency of a half-grown *Grape:* In every one of theſe is a ſingle *Inſect* perfectly form'd; ſo that it appears it has no Change after hatching.

I may yet add to this Chapter the *Ear-wig*, which we have not yet remark'd to have any Change of Figure after it is once hatch'd; but only when it is full grown we may diſcover its *Wings* folded up in ſmall Caſes upon the middle of its Body, as may be obſerved at Mr. *Dandridge*'s. I ſhall now proceed to conſider thoſe *Inſects* which we may call *regular*, ſuch as thoſe of the *Papilionaceous*, *Bee*, and *Fly* Kinds.

Explanation of the Plates relating to this Chapter.

PLATE XXIII.

Fig. I. *A* Land Snail *in a creeping Poſture.*

Fig. II. *The* Teeth *of the ſame* Snail *in the* Upper-Jaw, *done with the* Microſcope.

Fig. III. *The* Male *and* Female *Parts of Generation in the ſame* Snail. A: *The* Orifice *of the* Female *Part.* B: *The* Tube *of the* Male *Part.* C: *The* Glans *of the ſame.* D: *A Wire-like Sub-*

Plate XXIII

Fig. I

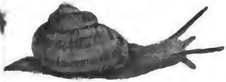


Fig. II.

Fig. III

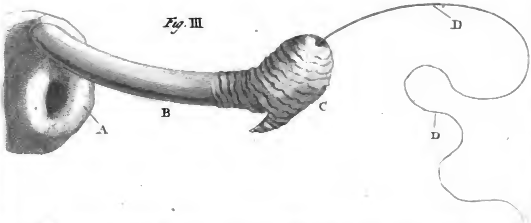
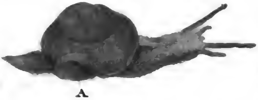
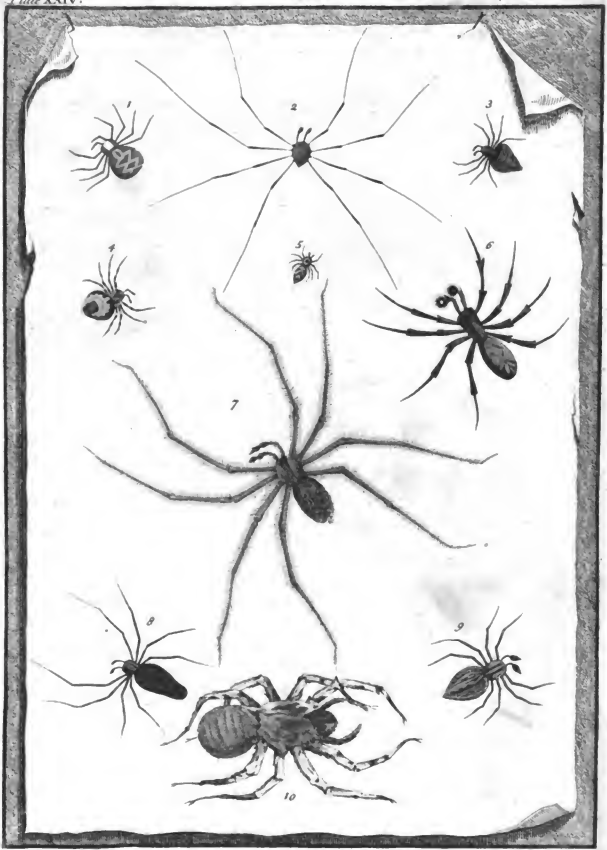


Fig. IIII



J. Cole sculp.

Plate XXIV.



J. Cole sculp.

Subſtance proceeding from the ſame; done with the Microſcope.

Fig. IV. *A* Snail *diveſted of its* Shell, *whereby we may diſcover the Situation of the Heart at* A.

PLATE XXIV.

Fig. I. *A* Garden Spider.
Fig. II. *The* Long Legs.
Fig. III. *An* Hedge Spider.
Fig. IV. *A* Garden Spider.
Fig. V. *The* Jumper *or* Tick Spider.
Fig. VI. *The* black Houſe Spider, *whoſe* Antennæ *are ſeemingly pointed with* Diamonds.
Fig. VII. *The* Velvet Long Leg'd Spider, *taken under the Eaves of a Houſe at* Newington.
Fig. VIII. *A* black Hedge Spider.
Fig. IX. *A* ſtrip'd Hedge Spider.

N. B. *All theſe are* Engliſh, *and may ſerve as Examples of the Nine Claſſes of* Spiders *in Mr.* Dandridge*'s Cabinet; whence they were taken.*

Fig. X. *The* Tarantala, *or* poiſonous Spaniſh Spider; *from the Royal Society.*

* * *

CHAP.

CHAP. XII. and XIII.

Of the Papilionaceous *or* BUTTERFLY *kind; and of* BEES, FLIES, *and ſome others obſerv'd with the Microſcope.*

AMONG the Creatures which have Life and Motion, we do not find any that poſſeſs a greater Share of Beauty in the Colours of their Cloathing, nor a more exact Symetry in the Arangement of their Parts, than the *Inſects* which make the Subject of this Chapter. To this we may likewiſe add the ſurpriſing Changes of thoſe Creatures, between the time they are in the *Egg*, and the taking *Wing*. Thoſe of the *Butterfly* kind are moſt commonly mark'd with the gayeſt Colours; and the *Moths*, which are regularly mark'd and variegated, have an agreeable Diſpoſition of the graver Colours: But however theſe are grave, or the others gay in the Colours they are adorn'd with, there is ſo juſt a Harmony between one Colour and the other, that we can never ſay the Grave is dull, nor the Gay ſurfeiting or unpleaſant. Both the *Butterfly* and the *Moth* have their *Wings* adorn'd with *Feathers*, as regularly diſciplin'd as thoſe in the *Wings* of *Birds*, tho' they are hardly to be diſcerned without the Aſſiſtance of *Microſcopes*, and is that which is falſly call'd the *Duſt* of their *Wings*. The Bodies of the firſt are divided into three Parts, (*viz.*) the *Head* join'd by a tender *Fillament* to the *Center* or *middle part* of their Body, and that again is more ſtrongly join'd to the *Tail*, which conſiſts of many *Annuli*. The Bodies of the *Butterflies* are long and thin; but thoſe of the *Moth* kind are thick and ſhort. All of the firſt Race have long ſlender *Antennæ* knotted at the Points; but the *Moths* have their *Antennæ*

Antennæ ſhort and feathered. And we may again make this Diſtinction between theſe two, that the *Butterflies* always fly in the Heat of the Day, and the *Moths* after the Sun is down. And I am the rather thus full in the Particulars of theſe Creatures, when they are in the *Winged* State, becauſe it is neceſſary to ſpeak of the Manner of their Generating before I treat of their *Eggs*. The Life of theſe Creatures, in this State of Perfection, is much longer in the *Butterfly* than in the *Moth* kind. I have known *Butterflies* live three Weeks; but I have never obſerved the *Moth* to live ſo long. The Manner of their Generating is equally performed by Coupling; but Mr. *Dandridge* makes this Remark of the Method of Coupling in *Inſects*, that the *Female* always enters the Body of the *Male*, contrary to all Creatures of other Kinds, which he ſays is the ſame with the common *Fly*, that we may more eaſily obſerve it. Immediately after the Coupling of theſe Creatures, they lay their *Eggs*, and are ſo obſervant (if they are at Liberty) of the Place they lay them upon, that we may be aſſured it is proper for their Hatching, and convenient for their feeding, when they are in the *Caterpillar*. If we examine their *Eggs* with a *Microſcope*, we ſhall find ſome of them *tranſparent*, and others *opaque:* The *tranſparent Eggs* are *ſterile* or *barren*; but the others will hatch at their proper Seaſons, if the Weather be agreeable to them. In the caſe of *Silk-Worms*, it is held by ſome People convenient to carry the *Eggs* to Church, upon the Feſtival of a certain Saint, by the Miſtreſs of the Family, who carefully wraps them up in a Cloth, and lays them in her Boſom, till ſhe has performed ſome particular Duty; the Warmth of her Boſom has ſo much Influence over the *Eggs*, that they hatch at her return home.

The *Eggs* of all the *Papilionaceous* Tribe have different Length of Time to hatch in, as their Originals are different in other Reſpects. Some will only lie a few Days, others two or three

Weeks, and others ſix or eight Months, without hatching: And again, the *Caterpillars* or *Nympha* of theſe Creatures have different Periods of Time allotted them for growing to their full Proportion; and their Form, in their *Nympha* State, are every one reſpectively agreeable to their ſeveral Tribes, and have ſome of them in that State the Appearance of eight and ten *Legs* apiece, although they never exceed ſix in number when they come to have *Wings*. They are frequently variegated with beautiful Colours, and often ſurpriſingly cloathed with *Hair*; and yet it is not to be obſerved, that either the *Hair* or *Colours* they poſſeſs, while they are in this State, is any way agreeable to what we find in them when they have got *Wings*: Nor indeed can we expect to find them ſtrictly the ſame, becauſe, while they are laid up in the *Chryſalis*, every part of the preceding *Caterpillar* ſeems to be reduced to a State of Confuſion, much more than we can imagine it was even in the *Egg* or unhatch'd State. All theſe, during the Time they are in the *Nympha*, feed upon the *Leaves* or *Flowers* of *Plants*: And we find by Experience, that Nature has appointed each particular Kind of *Inſect* to feed only upon a particular *Plant*; and even the ſame *Inſect* that is appointed to feed upon the *Leaves* of a *Plant*, will not feed upon the *Flower* of the ſame; but the *Flowers* have equally different Kinds of Deſtroyers as the *Leaves* have; and I think ſuch as feed upon the *Bloſſoms* or *Flowers* of *Vegetables* change commonly into *Moths*; but the *Leaf Eaters* are for the moſt part *Butterflies*. Some of theſe, when they change from their *Caterpillar* State into a *Chryſalis*, encloſe themſelves in Silken Bags; others make their Retreat under ſome Shelter; and others make their way into the Earth while they are in this State. Their Figures are all different, as were their *Nympha*. And as the Time required for the hatching of the *Eggs* of the ſeveral Kinds is as various as themſelves, ſo likewiſe the different Periods of Time neceſſary for the changing them from this ſtupified State to that of the *Fly* are as different; ſome of them only remaining thus for a few Days, others a few Weeks, and others ſome Months. What I here take notice of relating to the Food and Manner of breeding of *Inſects*, eſpecially that every diſtinct Kind of *Inſect* has a *Plant* peculiar to its ſelf to feed upon, I firſt learned from that excellent Lady the late Dutcheſs of *Beaufort*, whoſe Curioſity and Skill in Natural Knowledge gave Life to many Diſcoveries, which, without her happy Influence, would have lain uncultivated and uſeleſs to the World. This Lady had ſeen the Progreſs of many Kinds; and I believe has bred a greater Variety of *Engliſh Inſects*, than were ever rightly obſerv'd by any one Perſon in *Europe*.

When the *Papilionaceous* Race has got ſo far as to enjoy the Power of Flight, their extraordinary Frame and Colouring will afford us Matter enough for Admiration, eſpecially if we could have Opportunity of contemplating thoſe ſurpriſing Collections of Sir *Hans Sloane*, Mr. *Vincent*, Dr. *Ruyſh*, and Mr. *Seba*, where we may obſerve many thouſand Varieties of Foreign *Inſects*; and alſo in that curious Cabinet of Mr. *Dandridge*, who has ſo induſtriouſly collected the *Inſects* of our own Country: Some of the *Moth* and *Butterfly* Tribe being ſo large as to meaſure eight, nine and ten Inches between the extream Points of their *Wings*, eſpecially among thoſe which breed about *Amboina* in the *Eaſt Indies*, and might certainly be propagated with us if we had the proper *Plants* to feed them with, and perhaps might produce ſomething as uſeful as Silk, if we were to enquire into them. But while that Opinion reigns in the World, that we know enough already, and thereby the Search of Novelties is made ridiculous, we muſt be content to let many valuable Things lie undiſcover'd, as the *Magnet* did for many Ages. How uſeful are ſeveral *Earths*, *Vegetables*, and *Inſects* in Medicine, and in ſome other Caſes already diſcover'd; and why may we not hope ſtill to diſcover the hidden Virtues in other ſuch like Bodies. The *Silk-Worm*, at preſent, carries the Day before all others of the *Papilionaceous* Tribe, as it furniſhes the Principals of the gayeſt and richeſt Cloathing, altho' the Creature it ſelf has the meaneſt Appearance of any of its Claſs. I could inſtance many Particulars in this Place relating to the manner of breeding them, and of the Service they may be of to this Nation, if the Deſign, now begun at *Chelſea* for raiſing them, continues to be encouraged; but as Mr. *Barham*, F. R. S. one of the chief Undertakers of that Project, has already written largely of them, and continues daily to make new Diſcoveries and Obſervations, I rather chuſe to refer my Reader to the Works of a Gentleman, who has ſo much Experience in the Matter. It is enough to ſay of this Race, that they ſeldom fly higher than ten or twelve Yards from the Ground. And we may further remark, that the *Butterfly* and *Moth* Kinds never keep in Flocks, as ſome other *Inſects* do, altho' perhaps five hundred are hatch'd together from the *Eggs* of one *Dam*.

Mr. *Dandridge* obſerves that there are gradual Alterations from a perfect *Moth* to the *Bee* kind; and indeed, if we examine the twenty ſixth Plate, taken from his Cabinet, we may obſerve a juſt Progreſſion from one to the other. The *Antennæ* of all are alike, and their Bodies are juſt different enough to be diſtinguiſh'd from one another, bearing about the ſame Proportions of Difference that an *Horſe* does to a *Mule*, and a *Mule* to an *Aſs*. The *Wings* are four in each, thoſe of the *Moth* feather'd all over: Next to which is a degree of *Moth* with tranſparent *Wings*, feather'd only about one fourth part: The third with *Wings* like the ſecond, but thinly feather'd on the Edges. And laſtly, the *Humble Bee*, whoſe *Wings* have no *Feathers*; and ſo I doubt not but we might proceed as gradually thro' the *Bees*, *Waſps*, and *Ichneumon* Kinds to the *Flies*, and ſuch as have only two *Wings*.

But I come now to ſpeak of *Bees*, from whoſe induſtrious Race we are ſupply'd with Food, as the *Silk-Worm* contributes to our

Cloathing. The Induſtry of the *Bee* has given ſome Authors occaſion to write largely of them; and ſuch as have Glaſs Hives meet daily with ſome new Diſcovery worthy their Contemplation. The Method of building their *Combs* is ſo mathematically diſpoſed, that the Skill of the greateſt Artiſt cannot exceed the Juſtneſs and the Beauty of its Contrivance. The Hexagonal Figure of the Cells which compoſe the *Comb*, is ſuch as leaves no Vacancy or Space unemploy'd; but each reſpective Side of one Cell ſerves equally to make good a part of another, as it is well explained in the Account of *Bees*, in the *Hiſtory of the Royal Academy of* Paris *for the Year* 1712. The Matter of which the *Bees* make their *Wax* is chiefly the *Farina Fæcundans*, or *Duſt* of the *Apices* of *Flowers*, which they gather in ſmall Parcels; and lodge in the Cavities of their *hind Legs*, and even upon the *Hairs* which are diſperſed here and there upon their Bodies; for which reaſon I ſuppoſe that *Bees-Wax* may contribute greatly to Vegetation. Upon the coming home of one of theſe laden *Bees*, we may obſerve how readily he is diſcharged of his Burden by others of the ſame Colony. I have ſeen about ten or twelve *Bees* at work, to diſcharge one ſingle *Bee* of the *Wax* he has brought home, and convey it to others which were employed in building and framing the Cells; nor is their Labour in gathering the *Honey* from the bottom of the *Flowers*, nor their Diſcharge of it from their Bodies into the prepared Cells, leſs admirable. The Manner of their Breeding is yet Matter of Diſpute. Some Authors tell us, the *Queen Bee*, which is always larger than the reſt, is both *Mother* and *Queen* to the whole Colony; whereas, on the other hand, the chief *Bee* of a *Hive* is ſtiled the *King*: But however this be, we find by Experience, that where this Governour is wanting, and has by Accident been deſtroyed, the whole *Hive* decays and comes to Ruin. I have with great Pleaſure admired many of their Ceremonies about the Time of their Swarming, eſpecially three or four Evenings before they are going out:

The *Queen Bee* appears at the Mouth of the *Hive*, and is guarded at that time by four or five Ranks or Files of *Bees*, which ſtand before her in ſtrait Lines, fluttering their *Wings*, and making a Noiſe, without moving from their Place, leaving room enough between the Ranks for the labouring *Bees* to paſs backwards and forwards. The Time of their Swarming is commonly in *May*, unleſs we have a degree of Heat before that Seaſon which is equal to the Temper of Air at that Time, as it ſometimes happens in *February* or *March*. A curious Obſerver of *Bees* tells me, that he has known it practiſed, when a Swarm is inclinable to fly away, to fling Duſt among them, or, if they are out of Reach, the firing of a Piſtol will make them ſettle immediately; which, I think, carries reaſon enough along with it, conſidering how much an approaching Storm makes them hurry home to their *Hives*; I ſuppoſe, by preſſing the Air in an extraordinary manner, ſuch as the firing of a Gun or Piſtol will do. I could ſay much more relating to their Oeconomy, their Battles, Robberies, Manner of Burying their Dead, and deſtroying their Drones; but I rather refer my Reader to thoſe curious Remarks above mentioned, in the Academy of *Paris*, and other Books lately publiſhed concerning *Bees*, than trouble him with a Repetition of what is already printed. The Body of the *Bee* is divided into three Parts, very tenderly join'd together; the middle Part ſeems to contain the greateſt of their Strength, and in it ſeems to be the chief Reſidence of the Motive Power: To it are join'd the *Legs*, which are ſix in number; and the *Wings*, which are always four in the *Bee* Race, or ſuch as have Stings like *Bees*. Some of the *Humble Bees* which come neareſt in Form to the *Honey Bee* have Stings; but others more remote from that Figure have none. The *Waſp* and *Hornet* are in moſt Particulars like the *Tame Bee*, and are not without the Skill of compoſing their *Cells* and *Combs* in as artful a manner as thoſe of the *Bee* kind; but their Order and Diſcipline in other Matters does not ſeem ſo regular. All this Race have a Power of walking up ſuch Surfaces as are as ſmooth as a well plained Board.

It is obſervable as well in the *Waſp* as in the *Bee* kind, that if we cut their Bodies to pieces, every Part will retain Life for many Hours, ſuch as I have obſerved in the Fleſh of *Eels* and *Vipers*; which ſeems to agree in ſome meaſure with the Life in *Vegetables*, whoſe ſeveral Parts, being ſeparated from one another, will retain their Verdure for a long time, and even be diſpoſed to grow, if they are managed according to Art.

Next to theſe we may place the *Ichneumon Flies*, which have generally four *tranſparent Wings*, ſix *Legs*, and the Body divided into three, and joined by tender Veſſels like the *Bee* kind: Some of theſe lay their *Eggs* in the *Parenchymous* Part of *Leaves* and *Fruit*; others in the *Nympha* or *Caterpillar* of *Inſects*; every one of them having a proper *Matrix* for the hatching of its own *Eggs* or *Nidus*, diſtinct to it ſelf, in ſome living Body conſiderably different from it ſelf. I obſerve, that ſuch as lay their *Eggs* in the *Leaves* or *Twigs* of *Trees*, do that Work while thoſe Parts of the *Plant* are very tender, which they wound in ſuch a manner, and ſprinkle with a *Liquor*, which they emit when they lay their *Egg*, as changes the firſt *Vegetative* Intent, and diſpoſes the Parts of the *Leaf* or *Twig* to produce an uncommon Appearance, ſuch as the *Bliſters* upon the *Leaves* of *Oaks*, called *Oak-Berries*, and thoſe *Excreſſences* call'd *Oak-Apples*, which are occaſioned by theſe *Inſects*, and ſerve as *Neſts* to encloſe, nouriſh, and hatch their *Eggs*. Thoſe of the *Ichneumon* Race, which lay their *Eggs* in the Bodies of *Caterpillars*, have no further Care for the hatching of thoſe *Eggs*; the Body of the *Caterpillar* affording them every thing neceſſary, as well for their Hatching as their Nouriſhment, till they are fully perfected. Among the *Inſects* I have bred, I have found many of the *Ichneumon* Tribe come out of the *Aureliæ* of the *Butterfly* and *Moth* Kinds, after having devoured all the Moiſture of the Mother *In-*

ſect which they were hatch'd in; which has made ſome miſtake the *Aureliæ* of certain Kinds of *Butterflies*, to be the *Aureliæ* of *Ichneumon Flies.*

We next come to conſider the *Beetles*, a Race of *Inſects* whoſe firſt Food is, for the moſt part, the *Wood* and *Bark* of *Trees:* Theſe have as many Changes as the former: The Structure of their Bodies is in ſome Reſpects agreeing with thoſe of the *Bee* kind; the Bodies of theſe being divided into three, but more ſtrongly united together: The Caſe of the Bodies in theſe are hard and ſubſtantial; their *Legs* are always ſix in number, compoſed of a hard *Horney* Subſtance; they have two Pair of *Wings*, the uppermoſt very hard and ſtrong, which ſerve for Caſes for the other two, which are thin and tranſparent, and are ſo diſpoſed as to fold up or explain themſelves at the Will of the *Inſect*. Their *Creſt* or *Head* is hard, and commonly ſhining, and in moſt of them black as Jett, and of very ſurpriſing Forms; ſome of them having *Pinchers*, like the *Horns* of *Bucks* and *Stags*; others have their *Heads* imitating the *Rhinoceros*; others have *Horns* like *Bulls*, and ſometimes reſembling the *Snout* of an *Elephant*, which makes us diſtinguiſh them by the Names of *Bull-Beetles*, *Stag-Beetles*, &c. They have two *Eyes* a-piece, notwithſtanding the common Proverb, which tell us they are blind. Their Time of Flight and appearing abroad is in the Evenings; and the great Strength of their *Wings* and *Joints* is very remarkable, being able not only to reſiſt a conſiderable Force, but even to ſupport their Bodies in the Air, and carry them ſeveral Yards, with a Weight in their *Pinchers* of about three or four Ounces, ſuch as a *Wand* of half a Yard long, and about half an Inch diameter, which I have ſeen our *Engliſh Stag-Beetle* fly with ſeveral Yards. The *upper Wings* of theſe Creatures are ſometimes very finely variegated; and ſome of them appear as if they were made of ſolid Gold, ſhining through a tranſparent *Green*, *Blue*, or *Red* Colour. The largeſt Kind I have yet ſeen is the *Bull-Beetle*, whoſe Head and Body meaſures near four Inches; one of which Kind is now in the *Muſeum* of the Royal Society. The *Stag-Beetle*, from the *Eaſt Indies*, is likewiſe very large; and the Varieties of this Kind of *Inſect* are generally of ſuch remarkable Forms, that I think them no leſs worthy our Obſervation than the moſt curious animated Bodies. The Cabinets of Dr. *Ruyſh*, Mr. *Seba*, Mr. *Vincent*, Sir *Hans Sloane*, &c. are ſtored with theſe Rarities. Among theſe caſed Wing'd Creatures is the *Lady Cow*, which has likewiſe its Varieties beautifully ſpotted with the gayeſt Colours; and what gives me more than ordinary Satisfaction in contemplating this kind of *Inſect*, is, becauſe there is good reaſon to believe the *Cocheneel* is of the ſame Tribe. The late learned and curious Mr. *Petiver* has often told me, that in ſeveral Parcels of the *Cocheneel* he has found a kind of *Lady Cow wing'd* and *perfect*, which he ſuppoſed was the *Cocheneel Inſect* in its mature State. And Monſieur *Lewenhook*'s Obſervations, in *Phil. Tranſ.* N° 292, gives me a further Confirmation that the *Cocheneel* is an *Inſect*; and upon the foot of his Obſervations I have more than once made uſe of my *Microſcopes*, to examine the Form and Structure of this valuable Creature, by which I was confirmed in many Things related by Monſieur *Lewenhook*, to whoſe Account I refer my Reader; but cannot help obſerving, that about three Years ago I had a Preſent made me of ſome *Cocheneel* which grew in *Carolina*, and was found upon the *Prickley Pear*, or *Indian Figg*, growing in that Country, by a Slave, who had once been employ'd by the *Spaniards* in catching and ordering *Cocheneel* in their *American* Settlements; and I doubt not but it might be found in many other Parts of *America*, if we knew well how to look for it. By what I could learn from the Gentleman who brought it over, and had ſeen it grow, the *Inſect* is not *wing'd* when they gather it for Uſe, but rather in its third State, or laid up in its *Chryſalis*; he told me that ſome hundreds of them were found together in a kind of

Silken Web, which I ſuppoſe was of their own Spinning, and ſeems to determine that they could be then in no other State but in the *Chryſalis*, and by the *Microſcope* have an Appearance not unlike the *Chryſalis* of our common *Lady Cow*. It was found upon Tryal, that the *Cocheneel* from *Carolina* was in every reſpect as good as that brought from the *Spaniſh Weſt Indies*. For the better Satisfaction of my Reader, I have given him a Cut of the ſeveral Stages of our common *Lady Bird*.

The next Tribe of *Inſects* which I ſhall take notice of, is the *Locuſt* or *Graſshopper* Kind, whoſe Race is as numerous as any I have yet mentioned, as may be obſerved in the above-named curious Cabinets, eſpecially in that of Mr. *Vincent:* their *Caſe Wings* are not ſo ſubſtantial as thoſe of the former, but are as beautifully adorned. They have all *ſix Legs* a-piece; the two *hinder Legs* chiefly diſpoſed for Leaping, or raiſing their Bodies, till they can take *Wing*; but I can give no certain Account either of their Manner of Generating, or how they are brought forth, or proceed to their *winged* State. The Bodies of ſome of theſe are about three Inches long; and ſome ſorts that I have ſeen in Dr. *Ruyſh*'s Cabinet meaſure ſeven or eight Inches. It is obſervable, that this Race of Creatures have a Chirping Note or Voice, which is not remarkable in any other *Inſect*, but the *Pediculus Pulſatorius*, or *Death-watch:* For tho' other *Inſects* make a humming Noiſe, I ſuppoſe that to proceed from the quick beating the Air with their *Wings*, ſuch as may be produced by whirling about a Bit of Stick at the End of a String. And altho' the *Maſter Bee* of a *Hive* may be diſtinguiſh'd from the reſt, by its different humming Tone, the ſuperiour Size of its *Wings* may as well make his Sound different from the reſt, as the larger *Pipes* of his *Throat* (were they to be made uſe of as *Organs* of Sound) would produce a Note different from the ſmaller *Pipes* of the others, which are about one third leſs.

The next to theſe I place the *Libellæ*, or *Pond-Flies*, or, as ſome call them, *May-Flies*, or *Cadew-Flies*. The Bodies of theſe Creatures are divided in three, as the *Inſects* treated of before; and the *Tail* part of them is like the reſt, compoſed of jointed *Annuli*: To the central Part of their Body are joined their ſix *Legs*, and two Pair of *Wings*, curiouſly wrought, and of a Texture like fine *Gauze*: Their *Eyes*, which employ the greateſt part of their *Head*, appear like Glaſs: The Colours of their Bodies are for the moſt part tending to *Green*, *Blue*, or *Yellow*; and I have not obſerved above two Kinds of them which have had any *Red* about them. Mr. *Dandridge*, and the late curious Mr. *Petiver*, have both told me, that theſe *Flies* proceed from the *Cados-Worms*; but yet I have not been able to trace any one of theſe *Flies* to its original *Worm*. Nor can I be certain, whether the *Worms*, when they are caſed over, as I have mentioned in my Chapter of *Fiſh*, are then in their *Chryſalis*, or feeding State.

We come now to mention thoſe *Inſects* which are always Inhabitants of the Waters, as well in their *Nympha* as in their perfect State, ſuch as the *Water Scorpion*, *Cantharis*, *Water Beetles* of ſeveral Kinds, *Boat-Flies*, a *Monoculus*, and *Cramp Spider*, beſides ſeveral others of ſurpriſing Modes and Forms, which may be obſerved by the Curious. The *Cantharis Aquatica* has but four *Legs* regularly ſet on to his Body, and the ſame number of *Wings*, two of them *Caſe Wings*, and the others *thin* and *tranſparent*, which Mr. *Dandridge* tells me they have the Power of uſing even under the Water. The *Beetle* and *Water-Scorpion* are little various in the outward Structure of their Bodies, and have ſix *Legs* like the *Beetle* Kind upon the Land. But the *Boat-Flies* are very different from all other Kinds of *Inſects*, having their *Legs*, which are very long, placed about the middle of their Bodies; which ſerve as Oars to row them from place to place. The Shape of their Body is ſo like a common

Wherrey, that it gave them the Name of *Boat-Flies*. 'Tis obſervable, that this *Inſect* always ſwims upon its Back. Dr. *Deſaguliers* once ſhew'd me many of this Tribe in a Drop of Water, wherein *Leather* had been ſteeped, which were ſo ſmall, that the double *Microſcope* did not make them appear half an Inch long; and I ſuſpect that they are *Inſects* only in their *Nympha* State. At the ſame time the above ingenious Doctor, in Preſence of ſeveral Gentlemen, firſt gave me the Pleaſure of obſerving a wonderful *Inſect* which he had found in *Thames* Water, which had but one *Eye*, or perhaps one Globe of *Eyes*, placed in the middle of its *Forehead*. This Creature may be very eaſily obſerved in the Month of *July*, which is the common Time of its appearing in great Numbers. Its natural Size is about the Bigneſs of a *Flea*, which obliged us to have recourſe to the *Microſcope*, for the better viewing its Parts; we then obſerved that the *Head* was ſomewhat like that of a *Bird*, firmly joined to the Body, which was of an *Oval* Figure, ending in a pointed *Tail*. The Parts which ſeem to do the Office of *Legs*, and fling this Creature forward in the Water by regular Springs or Jirks, are almoſt like the *Claws* of an *Eagle*, and are two in Number, placed on each Side of its Belly: On the fore-part of its Body, near the Head, are placed two *Branches*, reſembling the *Dugs* of *Animals*, from which proceed ſeveral capillary *Spines*; theſe I did not obſerve had any Motion; and if one may judge of them by their Appearance, we might ſuppoſe them deſigned for ſuckling their Young; for this *Inſect* is *Viviparous*, which is contrary to other *Inſects* yet mentioned in this Chapter; for we did not only obſerve the young ones alive in the Belly of the Mother, but likewiſe ſaw ſeveral of them excluded from her Body. This curious *Inſect* I delineated with all poſſible Exactneſs, with the Aſſiſtance of Dr. *Deſaguliers*, and the Gentlemen then preſent.

The *Gnat* Kind next follows the *Water Inſects*, as they live the greateſt part of their Time in the Waters: Their Bodies, when they are in the *wing'd* State, are divided like thoſe of *Libellæ*; they have ſix *Legs* a-piece, tho' the Number of their *Wings* is not always conſtant: Some Kinds having four a-piece, and others but two; but they are all *tranſparent*, and their Texture much like that of the *Waſp*, or *Bee* Kind. This Difference in the Number of *Wings* is ſomewhat like that which we obſerve between the *Bee* and *Fly* Kind; and perhaps we might obſerve other as remarkable Differences as we do between the *Flies* and *Bees*. The *four wing'd* Kinds having, it may be, Stings, or ſome venomous Quality in them, and the others harmleſs as *Flies*. The learned Mr. *Derham* has obſerved above thirty ſeveral Kinds, and has remark'd the *Male* and *Female* either *in Coitu*, or has diſtinguiſh'd them by their *Antennæ*, or their Bellies, which are always larger in the *Females*, tho' unimpregnated, than in the *Males*. This curious Gentleman has given us a large Account of the Manner of the Generation of *Gnats*, in his excellent *Phyſico Theology*, where he tells us, 'That the *Culyces Maximi*, or 'the largeſt ſort of *Gnats*, lay their *Eggs* in *Meadows* under the '*Graſs*; and there is one of the middle ſort which lays its *Eggs* 'in dead Beer *Yeaſt*, &c. but all the reſt, which he had obſerved, lay and hatch in the Waters. The *Gnat*, which he 'mentions to lay its *Eggs* in dead Beer, hatches ſome time after 'into *Maggots*, which are ſo numerous, that the whole *Liquor* 'ſtirreth as if it was alive, in which were obſervable, ſome that 'were larger, others ſmaller; the larger are the Off-ſpring of 'our *Gnat*; the others of a ſmall dark colour'd *Fly*, tending to 'reddiſh, frequent in Cellars, and ſuch obſcure Places. All 'theſe *Maggots* turn to *Aureliæ*; the larger of which, of a *Tann* 'Colour, turn to our *Gnat*, which is of the unarmed Kind, 'having no Spear in its *Mouth*; its *Head* is larger than what is 'obſerved in the common *Gnats*, a longer *Neck*, ſhort jointed

'*Antennæ*, ſpotted *Wings*, reaching beyond its ſlender *Alvus*; it 'is throughout of a *brown* Colour, tending to *red*, eſpecially in 'the *Female*. The chief Difference between the *Male* and *Female* is, (as in other *Gnats*, yea, moſt *Inſects*) the *Male* is 'leſs than the *Female*, and hath a ſlenderer Belly, and its *Podex* not ſo ſharp as the *Females* is.

'That curious Gentleman obſerves, that ſuch of the *Gnat* Kind 'as are of the Water Race, lay their *Spawn* (ſome of them) 'above an Inch long, and half a quarter diameter, which floats 'in the Water; when theſe *Eggs* are, by the Warmth of the 'Seaſon, hatch'd into ſmall *Maggots*, they deſcend to the Bottom, where they make themſelves little Caſes, which they 'creep into and out of at pleaſure, until they are arrived to a 'more mature *Nympha* State, and can ſwim about to ſeek their 'Food; they are then a kind of *red Worm*, above half an Inch 'long; it then enters its *Aurelia* State, and from thence proceeds to its mature State, all as different as to Shape and Accoutrements, as if the *Inſect* was three different *Animals*. In its 'firſt or *Vermiculer* State, it hath a Worm-like Body, and ſwims 'about by Curvations, appearing like the Figure of an S; but in 'its *Aurelia* State it hath a quite different Body, with a *Club-Head*, (in which the *Head*, *Thorax* and *Wings* of the *Gnat* are 'encloſed) a ſlender *Alvus*, and a finny *Tail* ſtanding at right '*Angles*, with the Body quite contrary to what it was before, 'by which means, inſtead of eaſy flapping ſide-ways, it ſwims by 'rapped briſk Jirks the quite contrary way; but when it becomes a *Gnat*, no finny *Tail*, no *Club-Head*, but all is made in 'the moſt accurate manner for Flight and Motion in the Air, as 'before it was for the Waters.

This Account, as I am ſatisfied it is exact in moſt of the Particulars, may lead my Reader into a right Method of obſerving the others, and perhaps give him an Opportunity of diſcovering other ſurpriſing *Phænomena* in this wonderful Creature. 'Tis ſome of the *Gnat* Kind, in their *Nympha* State, which has oftimes given Occaſion to ignorant People to ſuppoſe that ſome Waters were turned to Blood; for I have ſeen Ponds and Ditches, about *Midſummer*, whoſe Waters appeared of that Colour, having all their Bottoms covered with theſe Creatures in their *Vurmiculer* State, which diſappear for ſome Yards Space upon touching only one or two of them, but creep out again of their *Cells* or *Caſes* in a Minute or two, and reflect their *red* Colour in the Waters: their Life is very ſhort in their perfect State; their chief Buſineſs then being Generation. I obſerve likewiſe, that the Time between the hatching of the *Egg*, and their taking *Wing*, is conſtant; which may be one Reaſon why we obſerve them hovering in Groups over or near the Waters, till they again return to them to lay their *Spawn.* Some of this Kind, as well as the *Cramp Spider*, are able to walk or ſtand upon the Waters. This Year I met with a kind of *Gnat* that had but four *Legs*, whoſe Motion was performed in the ſame manner of that of *Quadrupedes*. The *Wings* of theſe Creatures, and almoſt every other *Inſect*, explain and expand themſelves in a few Minutes, after they are excluded from the *Chryſalis*; and are not fully grown or explained, as ſome have thought, at the Inſtant the *Inſect* quits the *Chryſalis.* I have obſerv'd, with abundance of Pleaſure, at the firſt Appearance of the *Moth*, or *Fly*, that their *Wings* were only beginning to bud; but have unfolded and explained themſelves to their full State or Bounds of Growth, ſome in leſs than two Minutes, and others in three at moſt, which is a kind of *Vegetation* more ſpeedy than has yet been mentioned; and I the rather chuſe to call it ſo, becauſe we cannot diſcern that the *Wings* of theſe Creatures have any Share of *Senſation*, eſpecially ſuch as are *tranſparent*; and the Method of their joining to the Body of the *Inſect*, is ſomewhat like the rooting of *Plants* in the Earth; they receive their Nouriſhment from the Body of the *Inſect*, by thoſe capillary *Tubes* which make the Junction between the *Wing* and the *Inſect*. And if we conſider further, that the opening and explaining of the *Wings* of a *Moth* or *Butterfly*, is performed in about three Minutes; and that upon the ſame *Wings* there appears, almoſt in the very Inſtant of Time, a regular Plumage or Feathering; we muſt ſuppoſe the Time of the Growth of ſuch *Feathers* muſt be almoſt Inſtantaneous. I have obſerved ſome of the ſmaller Kind of *Gnats*, which have not lived above eight Hours after they had taken *Wing*, having taken them juſt when they were excluded from the *Chryſalis*, and kept them under a Canvas Caſe. This Share of Life does not much exceed the Life of the *Ephemeron*, which is ſaid to live but five Hours; but we muſt at the ſame time take notice, that both the *Gnat* Kind and the *Ephemeron* have a Share of Life much longer under the Waters, altho' under different Forms. We may ſee the Account of the *Ephemeron*, with its Natural Hiſtory and Anatomy, tranſlated by Dr. *Tyſon* from the Original of Dr. *Swammerdam*.

I now come to conſider thoſe *Inſects* which are of the *Fly* Kind, agreeing partly in Figure, and ſome other Reſpects, with the *Bee* Race. All of the *Fly* Kind have but two *Wings* a-piece, and are without Stings; they make no Proviſion for Winter, as *Bees* do; nor do they ſeem to have any Order or Oeconomy among them: Their Generation is performed by Coupling; they lay *Eggs*, which hatch into *Maggots*, that afterwards lay themſelves up in *Aureliæ*, and from thence change into *Flies*. The proper *Nidus* for their *Eggs* is commonly Fleſh of all ſorts, Dung of *Animals*, and whatever yields a Scent like *Carrion* entices them to it; and it is therefore they are ſo apt to ſwarm about the *Flowers* of the *Frittilaria Craſſa*, that ſtinks like putrified Fleſh, which is the proper Food for the *Maggots* of moſt *Flies* to feed upon. But it is obſervable, that all *Inſects* are thus carefully led by Nature, to lay their *Eggs* in ſuch Places, where their young ones may find convenient Food. There is indeed one ſort of *Fly* taken notice of by Mr. *Dandridge*, which tho' the Shape of its Body and Parts ſeem to agree very much with the common *Fly*, yet its Method of breeding its Young is very different. Theſe *Flies* aſſemble together, and hang to one another in ſo great a Number, as to make a Lump or Ball of about three Inches diameter: the Place of their Meeting is always upon ſome *Twig* over the Water, about *July* or *Auguſt*; while they are in that State, their young ones drop from them alive into the Water, after they have devoured all the Moiſture in the Bodies of the Mother *Flies*. This *Fly* is of a *greyiſh* Colour, and is the firſt of this Figure that I have heard of which is *Viviparous*, or that has its firſt Stage of Life in the Waters. Mr. *Dandridge* has now a large *Bunch* of them in his Cabinet: From the ſame curious Gentleman I likewiſe received the ſurpriſing Account of the *Male* and *Female Glow-Worm*, which I delineated from thoſe in his Collection, taken, *in Coitu*, by the Reverend Mr. *Maningham*, in which Creature the *Phoſphorus* or glim'ring Light they afford in dark Nights is not more remarkable, than the Difference of Frame and Parts between the *Male* and *Female*. The *Female* is flat and jointed, and is that which we commonly obſerve in the *Graſs* and *Hedges*; but the *Male* has *Caſe-Wings*, and many Parts agreeing with the *Beetle* Race; but whether it could produce a Light like that of the *Female*, I did not learn. The *Male* of this *Inſect* having *Wings*, leads me to a gueſs, that ſuch of the *Piſmires* as have *Wings* are *Males*, and perhaps leave the *Females* after they have made them pregnant, as the *Male Bees* or *Drones* are ſaid to do. In *Surinam*, and ſome other Parts of the *Weſt Indies*, there is a large *Fly*, which they commonly call the *Lanthorn Fly*, that is ſaid to yield a conſiderable Light. We have a good Cut of it in Madam *Mariana's Hiſtory of Surinam Inſects*, and the *Inſect* it ſelf is common enough in the *Amſterdam* Cabinets, and I think likewiſe in Sir *Hans*

Sloane's *Collection of Rarities*; but I do not yet find any rational Account of the Production of theſe Lights, no more than of that produced by rotten Wood.

The *Ignis Fatuus*, or *Jack in the Lanthorn*, I ſuppoſe to be no more than a Group of ſmall enlightned *Inſects*, rather than ſuppoſe it an enflameable Vapour, as ſome have taken it to be; for if it conſiſted of ſuch *Effluvia* or *Corpuſcula's*, as riſe from the Earth or Waters that were enflameable, and by ſome Cauſe or other had taken Fire, they could not be of ſo long Laſt or Duration as we find them to be; and beſides, we might as reaſonably expect, that all the *Effluvia* ariſing at the ſame time from the ſame Body of Water ſhould equally be enflameable as theſe, and ſo the whole Surface of the *Pond*, *Lake*, or *River* appear all in a Flame at one time. The ſudden Motion of this Light from place to place, very much agrees with the Motion obſervable in Groups of *Gnats*, which move in a Body ſometimes very ſlowly, and at other times drive together with great Swiftneſs. Happening to diſcourſe upon this Subject with the ingenious Mr. *Godfrey* the *Chymiſt*, that Gentleman told me, that he had often obſerv'd this enlightned Body in ſome Places abroad, and had caught ſome of the *Inſects* which help'd to compoſe it. But allowing it to be as I ſay, the Occaſion of the Light in ſuch *Inſects* remains yet to be diſcovered.

But this ſtrange Light has not given the Vulgar a greater Diſturbance, than that ticking Noiſe, which is commonly call'd a *Death-Watch*; and I therefore think my ſelf obliged particularly to take notice of it, and ſatisfy thoſe who are yet ignorant, that it is an *Inſect*. The learned Dr. *Derham*, in a Letter to me, mentions two ſorts of the *Death-watch*, one is about the Bigneſs and Shape of a *Louſe*, and the other a very ſmall *Inſect* made like a *Beetle:* theſe commonly are found in *July*, in duſty Places, where they are bred and feed. This curious Gentleman obſerves farther, that they tick only when they are about to generate; he gives us a Cut of the firſt Kind in its natural Size, and which with the *Microſcope* I have copy'd from him; but the other ſort I have not been lucky enough to find, tho' there are many of them (as I am inform'd) in the great Library at the Royal Society. See more of this Creature in *Phil. Tranſ.* N° 291.

The next kind of *Inſect* I ſhall take notice of is, of that Race which is call'd *Folium Ambulans*, or *walking Leaf*, which I have already treated of in my new *Improvements of Planting and Gardening*; 'tis a Creature which, if we take the Story of it right, partakes both of *Inſectal* and *Vegetative* Life, being nouriſh'd, as I have obſerv'd, as well by the Juices of the *Tree*, which the Mother *Inſect* lays its *Eggs* in, as by its own, which I ſuppoſe are ſo united, that one and the other circulate equally in the Body of the *Inſect*, till it ſelf, with the *Leaves* joining to it, drop from the *Tree*, and creep upon the Ground. In the above-named Work I have given Figures of two Kinds of this Creature, which are *Eaſt Indians*, and have referr'd to the Cabinets of Dr. *Frederick Ruyſh* and Mr. *Vincent* of *Holland*.

The *Inſects* we come now to take notice of, are ſuch as are of the ſmaller Kinds, *i. e.* thoſe in *Cheeſe*, *ſower Liquors*, *Pepper-water*, *putrified Paſte*, &c. The largeſt of theſe is the *Cheeſe-mite*, which however is not big enough to have its Parts diſtinguiſh'd by the natural *Eye*, but muſt be obſerv'd with a magnifying *Glaſs* to deſcribe its Appearance. We may remark, by the help of *Glaſſes*, that this Creature, however minute it is, has all its Parts regularly framed, and its Motion agreeable to larger *Inſects*, with *ſix Legs*. We may likewiſe be aſſured of its Generation, like other *Inſects*, by the Numbers a few will produce in a little time, and every one of them of the ſame regular Figure. In *putrified Paſte*, we may obſerve, with the *Eye* only, a Motion, tho' we cannot diſcern diſtinctly what Bodies they are that move in it; but if we put the Quantity of a Grain of

Sand of that moving *Paſte* into the *Microſcope*, and add to it as much Water, the fourth *Glaſs* of Mr. *Wilſon*'s *Microſcope*, or of thoſe *Glaſſes* made by Mr. *Scarlett* near St. *Anne*'s Church *Soho*, will ſhew them to be *Inſects* of an *Eel*-like Figure, about an Inch long. In the *Lees* of *Wine*, and upon the Outſides of *Wine-Casks*, we find great Varieties of living Creatures, which are very proper Subjects for the *Microſcope*; and even the *Moſſes* or *Moldineſs* found in ſuch damp Places as Cellars, and eſpecially where *Wine* is kept, gives us very entertaining Proſpects. *Vinegar* and *Pepper-water* likewiſe afford us abundance of Variety; but becauſe I have found it a little difficult to bring *Water* and *Pepper* into a right State of yielding theſe *Inſects*, I ſhall take this Occaſion to advertiſe my Reader how I brought it the Perfection I deſired; for I don't know any Author that has yet given the Receipt. About *June* I took a Pint of clear *Water*, and put to it five or ſix whole *Pepper-Corns*, which I expoſed in a Poringer to the open Air about three Weeks, I then found great Numbers of little *Animalcula* ſwimming in a ſmall Drop of it; but in ſome *Waters*, where I had put beaten or grownded *Pepper*, I could not diſcover any *Inſects*. We may further remark, that if we put *Hair*, *Leather*, or any part of *Animal* Bodies into *Water*, and let it ſtand for three Weeks or a Month, about *June*, *July*, or *Auguſt*, we find it fill'd with *Inſects* of various Forms; but I ſuppoſe the ſeveral Kinds, obſervable in the ſeveral *Waters*, have not their Original in thoſe Waters, but are ſeverally produced from *Eggs* lay'd there by ſome *Mother Inſects*, that are then in the Air, which reſpectively come to each of them, as to proper *Neſts* or *Nurſeries* for their Young; and I the rather am of this Opinion, becauſe if we can keep ſuch Bodies as uſually produce *Inſects* confined by Coverings of *Laun*, or ſuch like, we find no living Creatures in them. And again, as the *Mother Inſects* are of that diminutive Size, that they are not to be diſcern'd without *Microſcopes*, it is no wonder they can

lay

Plate XXV

FIG. I.

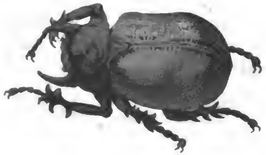


FIG. II

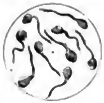


FIG. III.

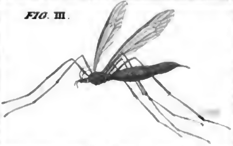


FIG. IV.

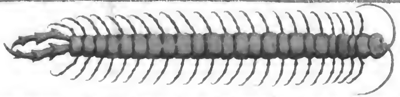
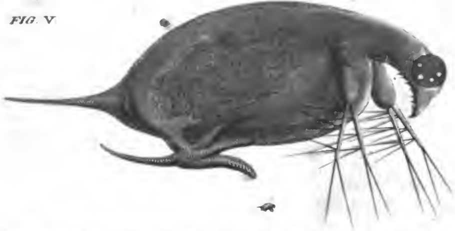


FIG. V



[illegible]

lay their *Eggs* in thoſe Mixtures without being perceiv'd; and I ſuppoſe the Air is full of them, eſpecially in the Summer Months, the ſmaller ſorts ſerving as Food to the greater; and it may be therefore that Nature has made the ſmalleſt Kinds more prolifick than the reſt.

I come now to conclude this Chapter with ſome Account of the *Animalcula* in *Semine Maſculino*, or ſuch minute Creatures as are found in the *Male Liquor* of living Bodies, which ſome of the Learned ſuppoſe to be the Rudiment or Principle of the *Fœtus*. In taking of this *Liquor* from the ſeveral Kinds of *Animals*, we find by the *Microſcope*, that the *Animalcula* are of different Figures and Bigneſs, as the *Animals* they were taken from differ in their Parts from one another. And theſe minute Creatures have ſo much Life and Spirit in them, that ſometimes they remain alive above three Weeks after they are taken from their Parent *Animal:* The different Opinions concerning their Progreſs into the *Matrix* of the *Female*, ſee in Dr. *Geoffroy*'s Letter in the Chapter of *Quadrupedes*, the Figures of one Kind of them I have delineated in Plate XXV. Fig. II.

Explanation of the Plates relating to this Chapter.

PLATE XXV.

Fig. I. *The* Bull-Beetle; *from the Royal Society.*
Fig. II. *The* Animalcula *in* Semine Maſculino.
Fig. III. *The laſt State of the large* Gnat.
Fig. IV. *A* Centipes; *from the* Weſt Indies.
Fig. V. *A* Monoculus *found in* Thames *Water, by the* Microſcope.

PLATE

PLATE XXVI.

Fig. I. *Shewing the Gradation from the* Moth A, *by* B *and* C, *to the* Humble Bee D.

Fig. II. A: *A* Water-Beetle.
B: Cantharis Aquatica.
C: *A* Water-Scorpion.
D: Cramp Spider.
E: Boat-Fly.

Fig. III. A: *A* Female Glow-Worm.
B: *The* Male Glow-Worm.

N. B. *The Contents of this Plate from Mr.* Dandridge.

Fig. IV. *The* Inſect *which blighted the* Horſe-beans *in many Parts of* England, Anno 1719; *from the Reverend Mr.* Lawrence.

PLATE XXVII.

Fig. I. A: *The* Eggs *of the* Silk-Worm.
B: *The* Nympha, *or* Caterpillar *of the ſame.*
C: *The* Silk-Bag *of the ſame, in which it changes into the* Chryſalis D.
E: *The* Male Moth *proceeding from the* Chryſalis.
F, *the* Female Moth *proceeding from the ſame.*

Fig. II. A: *The* Nympha, *or* Caterpillar *feeding upon the* Nettle, *which changes to the* Chryſalis B, *to the* Butterfly C.

Fig. III. A: *The* Death-watch, *of its natural Bigneſs.* B: *The ſame with the* Microſcope; *from the Reverend Mr.* Derham.

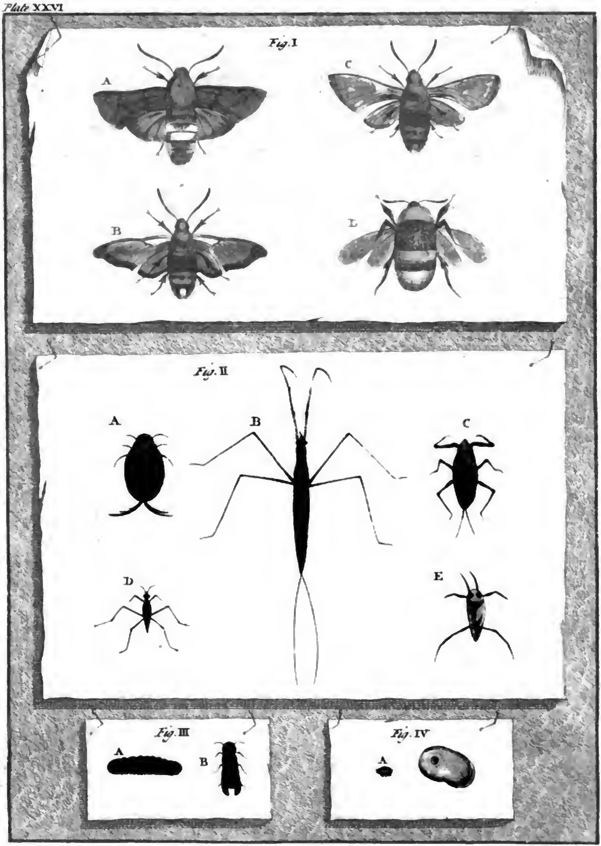
Fig. IV. A: *The* Nympha *of the* Lady Cow. B: *The* Chryſalis *of the ſame: and* C: *The moſt perfect State.*

Fig. V. *A* Prega Deos; *from the* Eaſt Indies.

Fig. VI. *An* Inſect, *from* Amboina, *whoſe natural Length is eight Inches; taken from the Cabinet of Dr.* Ruyſh *at* Amſterdam.

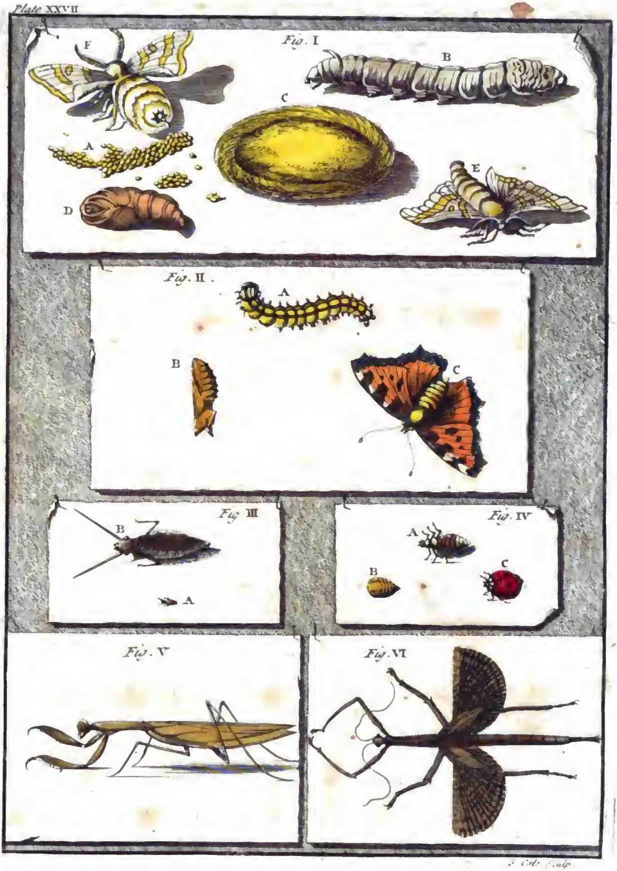
CHAP.

Plate XXVI



J. Cole Sculp.

Plate XXVII



J. Cole Sculp

CHAP. XIV.

Explaining the Uſe of the foregoing Remarks, with ſeveral Obſervations relating to CLIMATES.

IN the preceding Chapters I have given my Reader a general View of the Remarkables in the Works of the Creation, and have diſpoſed them in ſuch a manner, as may lead us to imagine that all Bodies have ſome Dependance upon one another; and that every diſtinct Part of Nature's Works is neceſſary for the Support of the reſt; and that if any one was wanting, all the reſt muſt conſequently be out of Order. It ſeems in this Caſe, as in that of Numerical Figures, each of which has a Power in it ſelf of filling a certain Space, without which the ſeſeveral Gradations in Numbers cannot be expreſs'd; and was there to be wanting any one of thoſe Figures or Powers, the reſt could not maintain a gradual Progreſſion of Numbers, but muſt frequently make ſuch Breaks and Chaſms as would run them into the greateſt Confuſion and Diſproportion.

We obſerve ſo exact an Harmony between Natural and Mathematical Proportions, as might give every thinking Man Reaſon to believe the latter could not have been without the former; or that the Laws or Rules of Mathematicks, as they now are, could not be juſt, if Nature's Laws were different from what we now obſerve them to be. In whatever falls under our Obſervation in Nature's Works, we may remark a conſtant Regularity, and a juſt Symetry and Proportion; the *Vegetables* have their *Roots* proportionable to the *Branches* and *Parts* they are to maintain; the *Animals* have their *Stomachs* agreeable to the Quantity of Food neceſſary for their Support; and even thoſe *Inſects* which are of the leaſt regard, have every Part diſpoſed with ſuch a juſt

Regularity and Property, as to bear an Analogy with thoſe in *Animals* of the greateſt Eſteem. The Frame and Figure of the Parts relating to every *Animal*, bears a right Proportion with the Body it is to move or direct: And the Length of Life in all Bodies is more or leſs, as any of thoſe Bodies are later or ſooner coming to their Perfection of Growth; for we obſerve, that ſuch Bodies as are moſt ſpeedy in their Growth, are proportionably ſhort-liv'd, and of ſmall Remain; and ſo on the contrary. In Muſick, there are ſeven diſtinct *Tones* or *Notes*, which ſingly expreſs a Power of *Sound* different from the reſt; and when any one of thoſe *Tones* is laid down as a Ground-work, the progreſſive *Tones* from that *Ground-Note* to the *Octave*, which is the Reſolve of the *Ground-Note*, declares the *Key*, either by a certain Number of *Semi-tones*, to expreſs Melancholy, in what is call'd a *Flat-Key*; or by a greater Number of *whole Tones*, to make the Expreſſion more briſk or poignant to the Ear, and then is call'd a *Sharp-Key*; but whether the *Key* be *flat* or *ſharp*, there is yet a regular Circulation of *Sound*, which is natural to the Ear, and may well enough be compared with the Circulation of Blood in the Bodies of two *Animals* of different Species, which tho' they both enjoy the Benefit of Circulation of Juices, the one is much brisker and more lively than the other.

The Diſtance between one *whole Note* and another may be divided into very minute Parts; but thoſe who have to do with imperfect Inſtruments, ſuch as *Organs*, *Harpſicords*, &c. content themſelves only with *Semi-tones* and *Quarter Notes*, in order to keep a tolerable Harmony in every *Key*; but a nice *Ear* may eaſily diſcover their Imperfection, eſpecially when they are ſtruck againſt a *Maſter Note*. In perfect Inſtruments, ſuch as the *Violin*, &c. every *Key* may be order'd by the Artiſt who plays upon it, to expreſs any *Sound* with ſo great Exactneſs, that the *Ear* cannot diſcover the leaſt Diſorder or Imperfection of the Harmony, the Juſtneſs of which may be compared to a healthful Body; the Imperfection of the other to a Body diſtemper'd, where the Circulation is not juſt and regular; ſo we may learn, that where there is a familiar Gradation without Breaks, a thing is natural, but otherwiſe unnatural.

To ſuppoſe that heavy Bodies can be rais'd on a ſudden, with the ſame Certainty that we could move them by gentle Degrees, would make us guilty of an Error. The *Jack*, the *Leaver*, the *Wedge*, and ſuch Mechanick Powers, will, by gentle Operation, perform, what the greateſt Strength cannot perform on a ſudden. A Man might jump down a Precipice and end his Life; but he might take time, and walk perhaps a Mile or two, and gain the Bottom with Safety; 'tis natural therefore to go Step by Step. The Caſe is the ſame in *Animal* Bodies, but moſt remarkable in the Human Race, where, in Health, the Beats of the Pulſe agree with the Vibrations of a *Pendulum*; but were we to provoke that Natural Courſe of the Blood to a quicker Motion, by invigorating Diet, ſhould we not find the Body and the Senſes indiſpoſed, and even ſometimes by Violence rob the ſeveral Parts of their natural Functions, and thereby occaſion Death? Were we to examine the Circulation of *Liquors* in the ſeveral Kinds of Bodies animated, we find the *Squirrel* and ſome others to have naturally a much quicker Pulſation than Mankind; and the *Snail*, &c. have a Circulation of Juices much ſlower; but muſt we therefore conclude, that a Man is in Health becauſe his Pulſe keeps time, either with that of an healthful *Squirrel* or *Snail?* The Parts of every diſtinct Creature are ſo order'd by Nature, as to receive, in a certain Capacity, the *Liquors* flowing through them; but were thoſe *Liquors* to move either quicker or ſlower than Nature appointed, in each reſpective Body, the Body they moved in would be diſtemper'd.

Heat and Cold are comparative Terms. Fire we ſay is hot, and Ice is cold; but we ſay that Water is cold, and the Weather at *Midſummer* is hot; but this Heat, or this Cold have their Degrees as much as Light and Darkneſs, or White and Black, or any other Colours. To ſay that a thing is *Red*, is not to expreſs what Colour properly it is of; there is the *Carmine*, the *Lake*, the *Vermilion*, and *Red Leads*, which ſhew us there are many degrees of Colour. Again, the Degrees of Heat are innumerable; one will melt *Gold*, another *Silver*, another *Copper*, another *Lead* and *Tinn*, another *Roſin* and *Wax*, and a leſs than that *Ice*. And now we come to ſay that *Water* is harden'd into *Ice* by *Cold*; and, as ſome ſay, *Chryſtaline* Bodies are conſolidated by a continued extreme *Cold*; but the hardening of *Water* into *Ice* happens only from a leſs Share of *Heat*, as the liquifying of *Wax* and ſome *Metals* is cauſed by a greater; ſo that *Cold* is only a leſs Share of *Heat*, and ſo the contrary.

The Great and the Leſs have their gradual Differences. A *Grain* of *Sand*, and the Terraqueous *Globe*, one may ſuppoſe at a vaſt Diſtance from one another, with reſpect of Magnitude; but alas, were we to make Compariſon between the *Globe* of *Earth* and the other *Planets*, we ſhould find a Difference almoſt as extenſive as between the *Grain* of *Sand* and our *Globe*; but between theſe Points of Magnitude there is room in Thought for innumerable Diſtinctions; ſo is it in the Appointment of Numbers, they ſeem capable of infinite Diviſion and Encreaſe. The *Tones* or *Notes* of Muſick are as diviſible. The gradual Encreaſe of Mechanick Powers is as extenſive, and the Vegetation of *Plants* is as gradual, as well as the Life and Growth of *Animals*. 'Tis therefore in this Introduction to Natural Hiſtory I have ſuppoſed a *Scale of Life*, or a Chain of created Beings; for if our Reaſon tells us we ought to move gradually, there is certainly a Gradation in Nature, and therefore that gradual Motion is natural and reaſonable, and whatever is not ſo is contrary to Nature and Reaſon; and I don't know a better way of bringing the unlearned to a right Judgment of Things, than by giving them a general View of Nature's Works, which at the ſame time may lead them into the way of Reaſon, and ſhew them the Wiſdom of the CREATOR.

All our Senſes are Witneſſes of theſe Gradations in Nature, by which we are taught to act with Gentleneſs and Deliberation in ſuch Things as are to be durable; for whatever is too haſtily gone about, or is forced to greater Speed than Nature appoints, muſt inevitably periſh before its due time; and it is from a juſt Obſervance of ſuch progreſſive Methods as Nature takes in the ordering and directing her Works, that our Reaſon is guided truly to our Advantage.

From Conſiderations of this kind we may learn how ridiculous it would be to ſuppoſe, that becauſe a *Plant* cultivated in the torrid Zone requir'd a greater *Heat* than we enjoy in our *Climate* to ſupport it in a due State of Health, that therefore the Heat of a Furnace would give it a quicker Vegetation; or to conclude, when we had kill'd a *Plant* or an *Animal* by an extraordinary Warmth, that therefore Nature directed it ſhould have none at all. There are certain Degrees to be choſen, agreeable to thoſe appointed by Nature, for the Support of each reſpective *Plant* and *Animal*; nor ought we to ſuppoſe, that becauſe we find a Gardener raiſes a proſperous Crop in one place, we may have the ſame Succeſs in another, without thinking reaſonably upon the Difference of the Soil or Situation: But yet have I known many Inſtances of Men, who have been Sufferers, by acting without Underſtanding in Caſes of this Nature. Some who have been enrich'd by a *Clay*, have been undone by following the ſame Rules upon a *Sand*; others have ſo far out-done *Natural Heat*, that they have conſumed their Gardens, and deſtroy'd all they had, without regarding that Nature has her Laws, which muſt be obey'd, and that ſhe acts with Gentleneſs, and will not be forced out of her Way. Thus it appears that an Art is only the true Knowledge of Nature, and that thoſe who do not really know the Natural Foundation of what they profeſs, are not Artiſts.

The more particular Uſe of this Scheme to Gardeners is, by directing them to conſider, that as every diſtinct *Animal* has its *Climate* and *Food* natural to it, ſo has every *Plant* an *Expoſure*, *Temper* of *Air*, and *Soil*, proper to nouriſh and maintain it in a rightState of Health: And again, as we find ſome *Animals* to delight in the *Waters*, ſome in open *Air*, and ſome under the *Earth*; ſo are there *Plants* likewiſe that have their reſpective Appointments in the *Waters*, as the *Lens Paluſtris*, or *Duck-meat*; and in the *Air* as moſt *ſucculent Plants*; and even under the *Earth*, as the *Truffle*; ſo in all Plantations we make, we ought to obſerve what *Element*, *Situation*, and *Soil*, relates to each, if we would be ſure of Succeſs.

To judge rightly of the Method of treating *Plants* brought to us from ſeveral Parts of the World, I conſider three Things. Firſt, The *Soil* of the Country they grow in, which I would imitate as near as poſſible. Secondly, The Time of the *Spring* in the Country they are natural to, and as near as may be the Degree of *Heat* in that Time of *Spring*; for as every *Plant* has its appointed Times of Reſt and Growth, it would be unnatural to force its Growth, when Nature ordain'd its Repoſe, or to abandon it to Repoſe, when it ſhould be aſſiſted by a Warmth agreeable to its own Country *Spring*.

To know the Time of *Spring* agreeable to every *Plant*, is firſt to learn the Latitude of the Country it grew in, and in the next place to conſider the Degree of *Heat* natural to that *Climate* in the Time of its *Spring*. To judge of the Time of the *Spring* in every Country, is to obſerve firſt in what *Zone* it lies, whether in the *Torrid Zone* (that is) between the *Tropics*, or in the *Temperate Zones* (that is) from each *Tropic* to the neareſt Bounds of the *Frigid Zones*, or from the *Polar Circles* even to the *Poles* themſelves.

The *Plants* which grow between the *Equinoctial Line* and the *Tropic* of *Cancer*, or to the Northward (*i. e.*) towards us, we ſuppoſe to have their *Spring* as ſoon as our Days lengthen: And as the *Sun* comes towards us more and more, all the Places between that *Line* and the *Tropic* are gradually enliven'd with *Spring*. At the ſame time, while the *Sun* moves this way to its *Boundary* or *Tropic*, which is about twenty three Degrees North Latitude, the Influence of it has its Operations on every thing gradually from the *Tropic* to the *Polar Circle*, and from that to the *Pole* it ſelf; ſo that if we judge of the Latitudes, as they are gradually placed in the *Maps*, and the Times and Degrees of *Heat* progreſſively moving through them, we cannot fail of giving every *Plant*, from any part on this ſide the *Line*, its Force or Warmth at the right Seaſon; and ſo we muſt maintain a due Regard to ſuch *Plants* as are Natives of thoſe Countries on the other ſide the *Line*. When the *Sun* begins to leave us, their *Spring* is then coming forward, and every Day encreaſes as much that way, as we on the North Side of the *Line* decline into *Winter*; ſo that whatever *Plants* we have from thence, we ought to help at that time, as we would our own in our own *Spring*.

We are moreover to remark, that as the *Sun*'s Motion and great Influence is between the *Tropics*; and that every Year its Motion is from South to North, and back again; ſo that Motion will produce two *Springs* every Year in each of the Countries it paſſes over, which *Springs* we may judge of, by enquiring into the *Sun*'s Courſe, which a common *Almanack* will ſhew us; and then allowing about ſix Weeks for the *Sun*'s Progreſs, before it can be directly over the Place we pitch upon, I ſuppoſe that will be the Time of *Spring* in that Country; for when the *Sun*'s Power is moſt violent in any Place, we find all *Plants* have finiſh'd their *Spring* Shoot, as we obſerve in *England* at the Time of our *Midſummer*, when the *Sun* is neareſt to us. In the *Temperate Zones*, ſuch as we have the Happineſs to enjoy, tho' the *Sun's*

Influence is more moderate, yet we may obſerve that the greateſt Share of *Heat* only ſerves to ripen our Fruits; but 'tis the gentle Warmth gradually encreaſing which makes our *Plants* vegetate, ſuch as the Warmth in *April*.

When the *Spring-Shoot* is perfected, and the great *Summer-Heat* is over, Nature begins to make a ſecond *Shoot*; but that *Shoot* is ſeldom of any great Conſequence in our Country; the *Sun*'s *Heat* declines, when our *Plants* want it to encreaſe, and the Attempt of Vegetation proves vain. I am of Opinion, were we then to give thoſe ſhooting *Plants* a convenient *Shelter*, and an additional *Heat*, regulated by a *Thermometer*, ſo that it ſhould be equal to that in the Month of *April*, we might even bring them to bear *Fruit* in the *Autumn* Seaſon. I have known ſome *Trees* which, without any help, have ripen'd ſome few *Fruit* of the ſecond *Spring*. 'Tis common enough in *Strawberries*, *Raſberries*, and *Cherry-trees*, eſpecially if the *Bloſſoms* of the firſt *Spring* have been taken off at their firſt Appearance.

When we have conſider'd the Time of *Spring* in the ſeveral Countries of the *Earth*, where we receive *Plants* from, we are next to enquire the Degrees of *Heat* in each of thoſe Places at the Time of their reſpective *Springs*, which we muſt imitate as near as poſſible; and I obſerve, that our *Midſummer Heat* is powerful enough to maintain any *Plant* brought us from between the *Tropics*; therefore, as we have it in our Power to give that degree of *Heat* at any time of the Year, by means of Fire, we may keep any *Plant* even from under the *Line* in our Conſervatories, regulated by a *Thermometer* at our *Midſummer* degree of *Heat*, which I ſuppoſe will agree well enough with the *Spring Heats* in thoſe Countries lying between the *Tropics*; and at the ſame time I would have an *Hygrometer* in the ſame Stove or Conſervatory, by which we might regulate the over Moiſture or Damps in the Air of the Houſe.

I find that in *England* our Air is generally ſo temperate, or the Paſſage from the *Heat* to the *Cold* is ſo gradual, that *Plants* which naturally grow eight or nine Degrees more South than we are, will grow here without any Shelter; but indeed they have this Advantage, that the Time of their Natural *Spring*, or awaking from their Reſt, is but a little different from the Seaſon of our *Spring*; ſo that when Nature appoints them to make their Shoot, the *Sun* is coming towards us, and backs them in their Attempt.

In my *Kalendar* of *Gardening* I have given a Deſign of a Greenhouſe or Repoſitory for *exotick Plants*; but for the Preſervation of the moſt tender Kinds, ſuch as grow near the *Line*, there is no one does ſo well as that contrived by the curious Monſieur *Le Cour* of *Leyden*, for the Production of that excellent *Fruit*, call'd the *Ananas* or *Pine-Apple*, from whoſe Model there are two or three now built in *England*.

But I think I have ſaid enough to inform my Reader how neceſſary it is to obſerve the Laws of Nature in the Preſervation of created Bodies, tho' I am not inſenſible that even the Contemplation of one created Body alone would afford Matter enough for a Book much larger than this Volume; but my Buſineſs is rather to give a general View of Things, than to enter upon Particulars with too much Freedom; and I chuſe to leave the Enquiry into the more nice Parts to the Curious, who have Leiſure and Opportunity to obſerve them.

By way of Concluſion to this Chapter, I am to take notice of ſome Particulars relating to Mankind, as I promis'd in my Chapter of *Quadrupedes*; for Man, altho' he is Lord of all, and has a Power of Ordering and Governing all living Creatures, which relate to our *Globe*, yet has he many Particulars in his Frame, which bear Analogy with the Parts of thoſe Creatures he is ordain'd to govern. The Harmony which Nature maintains in the Generation and Production of *Quadrupedes*, is not contradicted in HIM. The Functions of ſeveral Parts in Brutes direct them to perform what the ſame Parts would do in Mankind, was he not endow'd with Reaſon to guide him in his Actions, and over-rule what is brutal in him. But this is a Matter which relates more particularly to thoſe who make it their Buſineſs to conſult the Health and Welfare of Men, rather than to Natural Hiſtory, which is my preſent Subject. I ſhall content my ſelf with obſerving only ſome remarkable Particulars, which are not commonly taken notice of in Mankind.

The Longings in Women, and the Marking of Children, are Subjects which have occaſion'd Diſputes among the Learned; but I don't find either of thoſe Caſes yet determin'd, ſo that I cannot well omit a Conjecture or two of mine relating to thoſe Subjects. I ſuppoſe, when a Woman is pregnant, there is a regular Circulation of Juices through the Bodies of both the *Mother* and the *Fœtus*, admitting only that the Parts of the *Fœtus* ſubſiſt or are ſupported by ſuch fine Juices as we may ſay are diſtill'd from the Blood of the *Mother*; for the Parts fully grown are undoubtedly more capable of giving Paſſage to more groſs Juices than thoſe which are in *Embrio*, and in ſuch a minute Body; and in the *Fœtus* muſt be as fine as a ſubtle Vapour, almoſt equal to thoſe Spirits which nouriſh the *Brain* of a full-grown Body.

The *Fœtus* has its *Head* firſt form'd, and that, as well as all the other Parts, is regularly ſupply'd with Juices from the ſeveral Parts of the *Mother*, as they are analogous to one another; therefore, I ſuppoſe, as the *Brain*, both of the *Mother* and *Fœtus*, have an immediate Communication with one another, ſo I imagine the extraordinary Deſire of the *Mother* has ſo immediate an Effect on the *Brain* of the *Fœtus*, that it becomes diſtemper'd, and conſequently muſt affect the *Brain* of the pregnant Woman, and ſo both are out of order.

Again, the pregnant Woman, by touching any Part of her Body, when a ſtrong Deſire of any thing reigns over her, muſt have

Plate XVIII

Fig. III

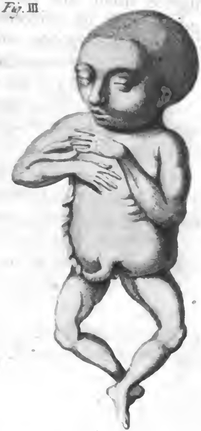


Fig. II

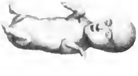
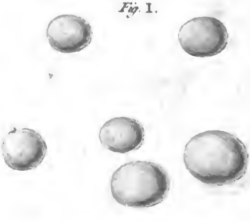


Fig. I.



J. Cole sculp.

have an extraordinary Power over the ſame Part of the *Fœtus*, and eſpecially becauſe things ſo ſmall and flexible will ſooner take an Impreſſion than others that are perfected; but this by way of Hint to the Learned. I proceed to take notice of the ſeveral Kinds of Men, whoſe Difference is remarkable.

We find five Sorts of Men; the *White Men*, which are *Europeans*, that have *Beards*; and a ſort of *White Men* in *America* (as I am told) that only differ from us in having no *Beards*. The third ſort are the *Malatoes*, which have their *Skins* almoſt of a *Copper* Colour, *ſmall Eyes*, and *ſtrait black Hair*. The fourth Kind are the *Blacks*, which have *ſtrait black Hair:* And the fifth are the *Blacks* of *Guiney*, whoſe *Hair* is *curl'd*, like the *Wool* of a *Sheep*, which Difference is enough to ſhew us their Diſtinctions; for, as to their Knowledge, I ſuppoſe there would not be any great Difference, if it was poſſible they could be all born of the ſame Parents, and have the ſame Education, they would vary no more in Underſtanding than Children of the ſame Houſe.

Explanation of the Figures relating to this Chapter.

PLATE XVIII.

Fig. I. *The* Eggs *taken from the* Ovary *of a* Woman; *by Dr.* Douglaſs.

Fig. II. *An Human* Fœtus *before Quickening*; *taken from the Royal Society*.

Fig. III. *An Human* Fœtus *after Quickening*; *taken from the Royal Society*.

PLATE XIX.

Fig. I. *A* Skeleton *of a* Man, *whereby the Difference in the* Oſteology *in the* Man *and other Creatures, may be obſerv'd.*

Fig. II. *The* Skeleton *of a* Monkey, *ſhewing the Difference between that and Mankind.*

CHAP. XV.

An Account of ſuch Lands in England *as are ſtiled* BARREN, *with ſome Propoſitions tending to their Improvement, and ſome Remarks relating to* FISH-PONDS.

IN my *New Improvements of Planting, &c.* I have endeavour'd to excite our *Engliſh* Nobility to planting of Timber, as well for the Uſe of their own Families, as for the publick Good; and ſince I find thoſe Papers have not been diſagreeable to the Publick, I am the more ready to publiſh what I have ſince obſerv'd in the Culture of profitable *Trees,* and the Method of Improving what we now call *Barren Lands.* I have often view'd our *deſolate Foreſts,* and *barren Plains* with an Eye of Pity, conſidering how much we were at the ſame time beholden to diſtant Nations for thoſe Commodities, which might with Eaſe be cultivated in our own Country, and which might turn to great Profit to our ſelves, and ſecure us from the Aſſaults of preſumptuous Neighbours.

In my Travels about *England,* I obſerv'd that we have three ſorts of Soil, which generally are counted unprofitable, ſuch as *Heath Ground, Chalky Hills* and *Plains,* and that which affords only what is call'd *dead Sand.* Some of the *Foreſts* indeed yield good

Plate XIX

Fig. I

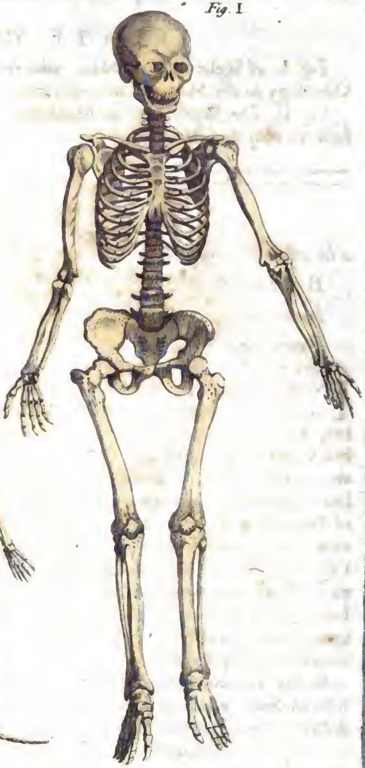
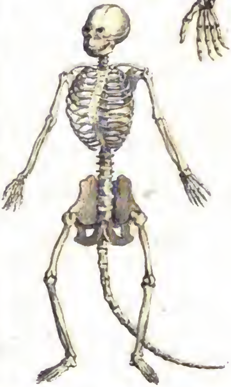


Fig. II.



good profitable *Land* for *Corn* and *Paſture*, and have formerly born valuable Burthens of *Trees*; as have alſo ſome *Grounds* belonging to private Gentlemen, from whence, upon Emergencies, has been reap'd conſiderable Crops of *Timber*, whoſe Price has even over-ballanced the Worth of the *Ground* it grew upon. And we have many late Inſtances of Eſtates which have been ſold, where, in a few Years afterwards, the *Timber* growing upon them was ſold for more Money than was given for the whole Purchaſe of the *Land*. In my former Works upon this Head, I have rated *Land* for *Timber* at five Shillings an Acre; but the *Ground* I ſhall treat of in this Chapter is ſuch, as is in very little Eſteem. The firſt I ſhall take notice of are the *Heaths* in *England*, which at preſent ſcarcely yield Food enough for *Sheep*, and are of no other Uſe. This ſort of *Land*, which is generally ſandy, and in which commonly we find abundance of *moraſs Ground*, I adviſe to be cultivated for the propagating of *Firr-Trees*, which are of very quick Growth, uſeful, and agree well with ſuch *Land*. We have ſome Inſtances of this ſort of *Land* cultivated in this manner in our own Nation; but in *Germany*, and ſome of the North Parts of *Europe*, we find whole *Foreſts* of *Firrs* growing in this kind of *Soil*. At the Earl of *Alresford's*, near *Guilford* in *Surrey*, we have an Example of the good Thriving of theſe *Trees* upon a *Hill* of common *White Sand*, in which one could hardly expect the leaſt *Vegetable* Quality; and, if I am informed right, the *Trees* now growing at that Place have not been planted there quite thirty Years, altho' they are now about forty Foot high; but it is to be obſerved, that they are hardly ſix Foot aſunder, which may be the Occaſion of their extraordinary Heighth, and the Clearneſs of their *Stems*, without Knots. The Experience I have had of this *Tree*, eſpecially the *Scotch Firr*, teaches me, that it thrives better raiſed from *Seed* upon the Spot where it is deſigned to remain, than if it is tranſplanted.

To make a Seminary of theſe *Trees*, we gather the *Cones* or *Fruit* of them in *September*, even while their *Rind* partakes yet of a *Green* Colour; for thoſe *Cones* which are already cracked and opened produce little or no good *Seed.* The *Cones* being thus gathered, we lay them in a dry Place during the Winter, and about *February* either expoſe them to the Sun till they crack and open, or elſe put them in ſome Veſſel into an Oven after the great Heat is gone off, by either of theſe ways we come at the *Seed* without difficulty, as I have tried with good Succeſs; tho' ſome have been apt to ſuſpect, that thoſe *Cones* and *Seeds* which are opened by the Heat of an Oven, would be too much dried to vegetate or ſpring in the *Ground:* When theſe *Seeds* are well cleaned, we ſow them thin in Beds, covering them about half an Inch deep with fine Earth, and in a Month's time they come up; but we muſt have great Care at their firſt Appearance to preſerve them from *Snails*, which are their greateſt Enemies: The ſame Summer they ſhoot hardly more than an Inch, and as their *Roots* lie very near the Surface, it is adviſable to ſift *Sand* over the Beds near half an Inch thick, about *September*, to keep them ſteddy, and prevent the Froſts from turning them out of the *Ground.* The ſecond Year they make *Plants* of about four Inches high, and if they were to remain in the ſame Bed the third Year, they would be near a Foot taller; but I hold it much better, if any of them are to be removed, that it ſhould be done when they are two Years old, and even then with extraordinary Care, laying them in a Barrow or Caſe of Earth, to be tranſported to the Place appointed for the great Plantation; and obſerve, that we do not take them out of this Earth, till the very Inſtant, if poſſible, that we are to place them in the Station where they are ever after to remain; for a little Air dries and ſhrinks the Coat of their *Roots*, and their *Parenchymous* Parts; ſo that they remain for a time without the Power of Growth, and perhaps rot or grow diſtempered by a Stagnation of the Juices. In this Plantation I would not adviſe them to be ſet more than ſix Foot a-part, which would be a means, as I have obſerved before, of their growing ſtrait and tall, unleſs indeed we would run the Hazard of tranſplanting ſome of them a ſecond time, and then the Diſtance between them need not be above three Foot, which would yet contribute ſo much the more to their aſpiring and up-right Growth, during their juvenile State; they might remain in this manner about five or ſix Years, and then it would be high time to draw every other *Tree* to make room for the reſt. The Method which has been uſed for tranſplanting *Firr-Trees* of this Age, and even ſome Years beyond it, with good Succeſs, was invented and firſt practiſed by the honourable *James Johnſton* of *Twittenham*, Eſq; who about *Midſummer* tranſplanted ſome of theſe *Trees* above twenty Foot high, in a Preparation of *Earth* and *Water*, of the Conſiſtency of a thin *Mud*, filling it up with fine *Earth*, till the *Root* of the *Tree* was firmly ſettled in it, by this Means the *Trees*, ſo planted, had made Shoots on their Tops above a Foot long the following Year, before the others which remained in the Nurſery had even began to ſhoot.

In my Chapter of *Vegetables* I have taken notice of a new invented Method of tranſplanting *Trees* with Safety, by means of a *Vegetable Mummy*, or Compoſitions of *Pitch*, *Bees-Wax*, *Turpentine*, and ſuch like; and I believe it would be of no ſmall Uſe in this Caſe, eſpecially if we were to tranſport *Trees* to any great diſtance. The anointing the *Roots* with ſuch Preparations, and eſpecially thoſe Parts where they have been cut or wounded, would keep them from drying, or ſhrinking up by the Air or Sun, and even contribute ſomewhat to their Growth. For the *Firr*, indeed, I rather recommend the anointing the *Roots* with *Turpentine* alone, or elſe mix'd with *Tallow*, which might eaſily be done with a Bruſh when it was warm; for the *Turpentine* I ſuppoſe cannot fail of giving ſome Nouriſhment to the *Tree* which naturally produces it. And the *Fat* of *Animals* is generally allow'd to aſſiſt *Vegetation*, as I have obſerv'd in my Chapter of *Vegetables*, where I recommend the Uſe of *Soap*, &c. to anoint the *Roots* of *Vegetables*, which ſee.

The *Scotch Firr* and *Pinaſter* are what I chiefly would adviſe to be planted for *Timber*, in *Sandy* and *Heathy Ground*, as they are both able to maintain themſelves in Variety of Seaſons. I have ſeen of both theſe Kinds, that have yielded profitable *Timber* for *Plank* or *Boards* in forty Years from the ſetting, as the People now living have aſſured me, that ſaw them planted and raiſed from *Seeds*. A Gentleman of *Devonſhire* has now many of them growing upon a *red Rock*, where they thrive exceedingly; ſo that the *Hills* in *Darbyſhire*, and ſuch others as are Rocky like them, need not deſpair of bearing one time or other this profitable Burden. But leaſt forty Years ſhould be counted too much time to wait, without receiving any Advantage, let us conſider the *Ground* was before the Plantation good for little or nothing; and in half the mention'd Space, the *Plants* which may be drawn out to thin the reſt will be fit for Scaffolding, or ſome other Uſes; and all this time the growing *Trees* are encreaſing in their Value, without any Expence or Labour, more than the firſt Charge.

But as *Heath Ground* is the Soil I propoſe for ſuch Plantations, and is for the moſt part in Common, it will be difficult to encloſe it. I think, however, the beſt Method to overcome that Difficulty, would be to ſummon the Poor of the Pariſh, who have chiefly the Right of Commoning, and parcel ſuch *Land* in as many Lots as there are Perſons who can juſtly claim a Right to it; and then the Choice among them, of the reſpective Parcels of *Land*, to be made by balloting, or elſe let them chuſe according to their Seniority, or the Length of Time that each of them or their Families have been Inhabitants of the Pariſh; by this Means every one of theſe poor People would find matter of Employment, and become Poſſeſſors of *Land*, which they might juſtly call their own, and thereby have Encouragement to cultivate and improve it: Theſe People ſtill being tributary to the Lord of the Manor, in proportion to the Value of ſuch Lands as they hold, and to be obliged alſo to plant a certain Number of ſuch *Trees* for *Timber* as the *Land* will beſt nouriſh. 'Tis my Opinion, that many of our Poor, which at preſent are troubleſome and expenſive, may by this Method be rendred uſeful to the Publick, and live in a contented State, enjoying every Man his own Right, without Encroachment from his Neighbours, or being ſubject, as the Commoners now are, to have the Benefit run only into a few Hands, while perhaps thoſe who have the greateſt Right, have hardly Paſture enough for half a Dozen *Sheep*, when others find Subſiſtance for two or three hundred.

Another way, which might tend to the Improvement and propagating of *Timber*, would be by obligating every Tenant at the renewing of his Leaſe, to plant certain Numbers of *Trees* at his own Expence. Where any conſiderable Plantation happens to be made, I would adviſe a *Stone* to be ſet up, with an Inſcription, intimating the Year, the Seaſon, and by whom planted, that it might be an Inſtruction to future Ages how long ſuch *Trees* have been growing, to produce the Sum they may then be ſold for, and inform the Poſſeſſor of the Perſon's Name, who ſo wiſely had the Foreſight to provide for him.

The other ſort of *Ground*, which next falls under my Conſideration, is the *Chalk*, ſuch as we obſerve, for the moſt part, on *Salisbury Plain*, and the waſte Grounds about *New-Market*; and I much wonder, conſidering the great Scarcity of *Timber* and Fire Wood in thoſe Countries, that no one has yet began any Plantation thereabouts, eſpecially ſince we have ſo many Inſtances of *Hills* and *Lands* of the ſame kind of *Chalk* in *Berkſhire*, *Oxfordſhire*, *Buckinghamſhire*, &c. which are cover'd with ſtately *Trees*, as well for *Timber* as Fire Wood. We there find the *Beech* is natural to that kind of Soil; and in ſome Places the *Engliſh Cheſnut* thrives pretty well, and the *Oak* indifferently; but the *Wallnut* rejoyces in that Soil, if it has any tolerable Shelter. I would recommend therefore to ſuch Gentlemen as have Eſtates about *Saliſbury* and *New-Market*, to take the *Hills* and *Chalky Grounds* of *Berkſhire*, &c. for their Example, and cultivate their *Lands*, which are of the ſame kind, after the ſame manner; ſo that in time they might ſave the Expence and Trouble which they are now at, in ſending many Miles for their *Firing* and *Timber*.

The *Beech*, which is a Lover of this Soil, grows much quicker in it than in ſome *Lands* which are counted much richer, and is raiſed from the *Maſt* without any difficulty, carrying this Conveniency along with it, that the *Seed* does not come up till the ſecond Year; ſo that upon the firſt plowing of the *Ground* we may ſow the *Beech-maſt*, and ſome kind of *Grain* at the ſame time, and reap a profitable Crop of *Corn* before the young *Beech* appears, to bear the Expence we have been at in laying up the Ground. In twelve or fourteen Years we may begin to reap ſome Advantage from this new *Wood*, by cutting and thinning ſuch of it as is fit for Fireing. If we had a hundred Acres planted in this manner, we might cut about an eighth part at one time, and at that rate have a continued Supply from Year to Year; the firſt growing up by that time we have cut the laſt; and the laſt renewing it ſelf again by that time the other ſeven Parcels have had their ſecond Cutting.

The *Engliſh Cheſnut* is likewiſe a very profitable *Tree*; and tho' I have already mention'd it in my *New Improvements of Planting*, &c. yet I cannot help taking notice of the extraordinary Bulk that *Tree* will grow to. Mr. *Greening*, a very ingenious Nurſery Man at *Brentford*, tells me, that at the Seat of the Lord *Ducie* at *Tartworth* in *Glouceſterſhire*, there is now growing an *Engliſh Cheſnut*, which he meaſured, and found the *Girt*

Girt fifty one Foot about, ſix Foot above Ground; this *Tree* divides it ſelf at the *Crown* into three *Limbs*, one of which he meaſured twenty eight Foot and a half in the *Girt*, five Foot above the *Crown* of the *Tree*, which extraordinary Meaſure of the *Limb* only, is almoſt equal to the bigeſt *Oak* in *England.* He obſerved that the Soil was a ſoft *Clay*, ſomewhat Loomy, and the Situation on the North-Weſt Side of a *Hill:* This *Tree*, he tells me, was mentioned in a Book dedicated to King *John*, and was then ſtiled the *Great* or *Old Cheſnut Tree* at *Tartworth*; ſo that it is ſuppoſed it muſt be now above a thouſand Years old. At the ſame Seat, near the Place where this wonderful *Tree* now grows, my Lord *Ducie* told him he lately cut down an *Elm*, out of whoſe *Limbs* were made a hundred Pair of Stocks for Cart-Wheels, and whoſe Body alone was ſold for two and twenty Guineas upon the Spot; from whence we may learn how much a *Loomy Soil* contributes to the Growth of *Trees* of this ſort.

In *Marſhy wet Grounds* the *Oſier*, *Alder*, and *Arbeel*, turn to good Account; and may every one of them be raiſed from *Cuttings*, or *Truncheons* ſet in the *Ground*, (as I have directed in my Book of Gardening) even tho' it be covered two or three Foot deep with Water; eſpecially the *Oſier* and the *Alder* would in time, by the matting or entangling of their *Roots*, and continued Fall of their *Leaves*, bring it to ſolid *Ground*; but *Water* in ſome Caſes is as profitable as the *Land* it ſelf, as I ſhall obſerve by and by; in the mean time let me adviſe, that where *Banks* are neceſſary to keep *Land* from the overflowing of adjacent *Rivers* or *Lakes*, there is no way of making them ſo ſolid and laſting, as by backing them well with *Stakes* of *Willows*, which ſtrike *Root* without any Trouble, and intermix with one another in ſuch a manner, that in a few Years only they become as one Body.

But I come now to ſpeak of *Fiſh-Ponds*, and to mention ſome Obſervations concerning the Number of *Fiſh*, which a certain Quantity of *Water* will maintain. It has been obſerved, that every kind of *Fiſh* requires a certain Depth of *Water* to maintain it ſelf in; the ſmaller ſorts delighting and thriving in ſhallower *Waters* than the greater; and theſe *Waters* are more or leſs nouriſhing to ſome *Fiſh*, as they paſs through different *Strata*, or Beds of *Earth*, every kind of *Earth* giving its *Tincture* to the *Waters* paſſing through it, or joining with it. The moſt nouriſhing *Waters* for *Carp*, are ſuch as are found in *Heathy Grounds*, which are commonly of a *Sandy Soil*; and if it is poſſible to chuſe the Situation of a *Pond*, it is counted much better to have it near the bottom of *Hills*, that upon the Fall of great Rains may waſh down *Inſects*, and other nouriſhable Matter into it; and if it could be contrived, the *Water* ſhould be always current through it; where this happens, the ſame Fund of *Water* will maintain one third more of *Fiſh* than it would do, if it was only a ſtill *Water*. In the making of a *Pond*, we ought to contrive, that it may have all degrees of Depth as far as ſix Foot; for if the *Fiſh* happen to breed in it, the young *Fry* or *Spawn* muſt have ſhallow *Water* to live and ſwim in; and the *Spawn* it ſelf, while it is in the *Egg*, would be unfruitful, was it to lie in deep *Water*. Again, as the young *Fiſh* grow bigger, they change their Station more and more towards the Deep, till they become of a fit Size to breed and produce others. It is rarely known, that in a good breeding *Pond* the *Fiſh* ever come to be very large; for the Number of them become ſo great, that they over-ſtock the *Water*, and are ſtraitned for Food. I have been told, that where the ſhalloweſt part of a *Pond* is about two Foot in *Water*, that neither *Carp*, *Pike*, *Tench*, or *Perch*, will breed in it, becauſe it is too deep for the *Spawn* to hatch, if the *Fiſh* ſhould be enclined to lay any, and in ſuch Places an ingenious Gentleman obſerves the *Fiſh* grow very large, and thrive apace,

pace. if they were at firſt rightly proportion'd to the Quantity of *Water*, and put in at a right Age. An Acre of *Water*, he tells me, (if all the Parts of the *Pond*, one with another, meaſure three Foot deep) may well enough bear ninety Brace of *Carps*, which is about a Rod of *Water* to each *Fiſh*; or elſe, as he obſerves, eighty Brace of *Carps* and twenty Brace of *Tench*, and ſo in proportion for every ten Brace of *Carp* wanting, he allows twenty Brace of *Tench*. Theſe *Fiſh*, he ſuppoſes, delight to be together; and remarks, that the *viſcous* Matter upon the Bodies of the *Tench* is often ſerviceable to ſuch *Carp* has have by Accident been wounded. It is found by Experience, that both theſe Kinds of *Fiſh* thrive much better in old *Ponds*, than thoſe that have been newly made; and he gives this Reaſon for it, That in a *Pond* newly cut or dug, the Water is not all of one piece, or partaking of the ſame Qualities, which it muſt have ſufficient Time to draw from the Earth, and circulate through, or mix with every part alike of the *Water*; for he holds it as a Maxim, that *Fiſh* never thrive which have any Change of *Water*, after they are two Years old, and therefore always ſtocks his *Ponds* with Store of the ſecond Year. To experience this, he told me, that in one *Pond* he put in at the ſame time *Carps* of the ſecond Year, ſome of the fourth Year, and ſome of eight Years old, marking thoſe of the two laſt Age: Five Years afterwards he drew the *Pond*, and found that the young *Fiſh* of the ſecond Year were much larger than any of the others; which happen'd, as I ſuppoſe, for the ſame Reaſon that young *Plants* are more eaſily tranſplanted, and thrive much better, than elder *Plants* that have ſtood long enough in a Soil to be naturaliz'd to it; or that People, that have been bred up from their Infancy, and a long time breathed their Native Aire, grow ſickly upon changing it; juſt ſo does the changing of *Fiſh* from one *Water* to another alter their Conſtitution. 'Tis likewiſe obſervable, that a Plantation of *Trees* too near a *Pond* is apt to infect the *Water* with its falling *Leaves*; but, on the other hand, Shelter is neceſſary, and is much the beſt, as it conſiſts of *Herbs* and *Plants* which naturally grow in the *Waters*, ſuch as *Water-Lillies*, *Pond-Weeds*, and *Flags*, which breed and afford a great Number of *Inſects* for the *Fiſh* to feed upon, and help to guard them from the too great Heats of the Sun; but chiefly I am told theſe *Weeds* are uſeful to *Pikes* and *Perch*, and that they are better fed *Fiſh*, and much larger in ſuch *Ponds*, than where they have only a naked *Water*. The *Pike* being a *Fiſh* of Prey, will admit of no *Fiſh* to abide with it but the *Perch*, and that only avoids the voracious Appetite of the *Pike*, by means of the thorny *Finns* on its Back. In theſe *Ponds* however it is commonly practiſed to fling in a Parcel of *Roach* for the Food of the *Jacks*; and I knew a Gentleman, that thought it worth his while to ſtock his *Pike-Ponds* with *Frogs* for the ſame Uſe. Theſe, as well as the *Carp* and *Tench*, may be fed with Blood and Bran mixt together, Raſpings of Bread, or the Entrails of *Fowl* or *Sheep*; and if they are regularly uſed to be fed in this way, at a conſtant Hour and Place of the *Pond*, they will in a ſhort time become undaunted, and feed before us, which is all I ſhall ſay at this time relating to *Pond-Fiſh*.

CHAP. XVI.

Of the moſt curious GARDENS *in* Europe, (*eſpecially in* Britain) *and what may be learnt particularly from them*; *with ſome Remarks and Experiments relating to the Improvement of* FRUIT-TREES *and* FLOWERS, *never before made publick.*

BESIDES the innocent Diverſion which is found in a *Garden*, by cultivating many of the greateſt Beauties of the Creation, Mankind may gain immediate Advantage, by reaping the *Fruit* of his Labours. The Health of the Body is moreover maintain'd or encouraged, if we give our helping Hand towards the propagating of *Vegetables*. A gentle Exerciſe in a freſh Air, where the Mind is engaged with variety of natural Objects, contributes to Content; and it is no new Obſervation, that the Trouble of the Mind wears and deſtroys the Conſtitution even of the moſt healthful Body. All kinds of *Gardens* contribute to Health; but every one is not equally advantageous or profitable. There are *Gardens* of Grandeur and Recreation, ſuch as thoſe of the inimitable *Verſailes*, thoſe at *Marli* and *Trianon*, belonging to the King of *France*; and in *England*, the Royal *Gardens* at *Kenſington*, regulated by Mr. *Wiſe*, afford as many agreeable Varieties as any in *Europe*, where the Situation is flat, and the Command of Water is wanting. The *Gardens* at *Kenſington* have not indeed the Extent of thoſe which I mention in *France*, nor had the Director of them the Happineſs to make them all at one time, but was content with giving now and then a Beauty as Occaſion offer'd. The Irregularities which I remember were in the Ground, when he took the laſt part of them in hand, has particularly ſignalized his Judgment; ſo that we are led to an Imagination of the Beauties that would have appear'd in them, if they had ſtill been more irregular when he undertook them.

The Royal *Gardens* at *Hampton-Court*, under his Care and Direction, are famous for the Variety of *exotick Plants* brought from moſt Parts of the World, but more eſpecially for the healthful Condition of them, and exact Symetry in the diſpoſing them in their ſeveral Conſervatories; and it is here that we have Example of *Orange-Trees* bearing plenty of *Fruit*, in as great Perfection as we can deſire, which ſurpaſſes what I find at *Verſailes*; ſo that we may judge how much the Skill of a Director is neceſſary to contrive and manage in ſuch a Caſe; for tho' the *Trees* at *Verſailes* are extraordinary large, and in great Numbers, they were without *Fruit* when I was there; ſo that I cannot enough commend the Ingenuity of Mr. *Archer*, who is the preſent Manager at *Hampton-Court* under Mr. *Wiſe*.

The *Verſailes Gardens*, as they are of vaſt Extent, and have coſt ſuch Sums as perhaps no Country in *Europe* is worth; ſo it would be of little Uſe to deſcribe their Particulars; but in general we may ſay this of them, that their Order and Contrivance has been as well Poetically as Mathematically ſtudy'd, each reſpective Part has a juſt Proportion with the Hiſtory repreſented in Statues and Water which it contains; ſo that we never obſerve too many, or too few Statues, or more or leſs Water than the Imagination can expect, and ſo near Nature is the artful Contrivance of theſe *Gardens*, that we are led with Expectation and Deſire throughout the whole; but we muſt ſtill obſerve, that in this Wonder of a *Garden* there is neither *Graſs*-work nor *Gravel*, nor the beautiful Ornaments of variegated *Hollies*, which is the Glory of the *Engliſh Gardens*.

Was I to give a particular Deſcription of our *Engliſh Gardens* for Pleaſure, which the Curious, among our Nobility and Gentry, have brought to Order; a large Volume would not contain their Account. Some are happy in their Situation for *Caſcades* and *Jet d'eaux*; others have their Beauties in agreeable Proſpects; and ſo likewiſe was I to deſcribe the *Gardens* of Particulars in *France*, we ſhould find them abound in natural Beauties, and only wanting of thoſe Ornaments in which we exceed moſt other Parts of *Europe*, viz, *Graſs*, *Gravel*, and Variety of hardy *Ever-greens*. Again, the *Gardens* in *Holland* have very different Appearances and Modes from thoſe in *England* and *France*; the *Holland Gardens* are not indeed without Water, but it is commonly ſuch as is of no Uſe either for Water-works, or common Service to the *Plants*; for the Country is level, and the *Canal* Water commonly ſalt or brackiſh, ſo that I have often ſeen Boat-loads of freſh Water brought from a great Diſtance; but the *Canals* which encompaſs and bound the *Gardens* have a very good Effect, being aſſiſted with the Ornaments of *China*, and gilt Pots and Vaſes, with Statues, and Arbours or Cabinets of *Latice* Work, which together afford an agreeable Proſpect; but *Holland*, no more than *France*, poſſeſſes the Beauties of fine *Graſs-Turf*, or *Gravel*, or the Ornament of our *Engliſh Evergreens*; nor indeed is the Soil ſo natural to moſt *Herbs* of the *Kitchen-Garden*, as it is generally in *England*; which one may eaſily obſerve, by comparing the Produce of one with the other; but for bulbous *Roots* we find it to produce Wonders, which has given me occaſion to conſider the Nature of that Earth more particularly; it is compoſed of fine *Sea Sand*, with a Mixture of *Turf* or *peat Earth*, which ſeems to be two Thirds of the former, and one of the latter; and the Benefit of this kind of Soil in propagating bulbous *Roots*, has made the *Hollanders* famous, eſpecially in *Tulips*.

Lately I have obſerv'd, that our *Heath Grounds*, which is moſt like the *Holland Soil*, yields very good *Saffron*, and even produces a better Crop than the *Chalky* Soil about *Saffron Walden*; upon the latter, an Acre of Ground, in its full Strength, brings about twelve Pounds of *Saffron* in a Seaſon; but the *Saffron Roots* in the *Heath Ground* bring more *Flowers*, about one ſixth part. 'Tis to be noted, that all the *Saffron Grounds* are ſubject to be deſtroy'd by *Hares*, and therefore are encloſed with *Hurdles*: And again, the ſecond or third Years of planting thoſe *Roots* give the greateſt Crops; for they muſt be ſeparated or tranſplanted after the third Year's bearing, or elſe they produce little. But to proceed.

The profitable *Gardens* are of three Kinds; firſt, thoſe cultivated for *Kitchen* Uſes; ſecondly, the *Nurſeries* for Improvement of *Timber*, *Fruit*, &c. and thoſe which are diſpoſed for the Uſe of Phyſick, and are the *Seminaries* and *Nurſeries* of *exotick Plants*.

The firſt, which are *Kitchen Gardens*, and exceed all the other *Gardens* in *Europe* for wholeſome Produce, and Variety of *Herbs*, are thoſe at the *Neat-Houſes* near *Tuttle-fields*, *Weſtminſter*, which abound in *Salads*, early *Cucumbers*, *Colliflowers*, *Melons*, *Winter Aſparagus*, and almoſt every *Herb* fitting the Table; and I think there is no where ſo good a School for a *Kitchen Gardener* as this Place; tho' *Batterſea* affords the largeſt natural *Aſparagus*, and the earlieſt *Cabbages*. Again, the *Gardens* about *Hammerſmith* are as famous for *Strawberries*, *Rasberries*, *Currants*, *Gooseberries*, and ſuch like; and if early *Fruit* is our Deſire, Mr. *Millet*'s at *North-End*, near the ſame Place, affords us *Cherries*, *Apricocks*, and Curioſities of thoſe Kinds, ſome Months before the Natural Seaſon. I could mention ſeveral particular *Gardens* about *London*, where I've found an Excellency in the *Gardeners* belonging to them; but as there are Accidents which happen every Day that may occaſion the Removal of the Artiſts from thoſe Places, it will be of little Uſe to name them in this Work, but rather take notice of the Famous among them in ſome other Treatiſe, where I may have a better Opportunity of ſetting forth their ſeveral Merits.

The *French* in their Kitchen Gardens propagate *Muſhrooms* in large Quantities; and indeed about *Paris* the Gardens are chiefly employ'd in this way, ſo that the Markets are plentifully ſtored with them at all Seaſons in the Year; and I have often wonder'd, that yet none of our *Engliſh* Gardeners take up that Buſineſs, conſidering the Profit which would accrue to them from ſuch an Undertaking: If they are ſtill without Knowledge of the Method of raiſing them, they may ſee the Direction in the ſecond Chapter of this Work. For the reſt of the *French* Kitchen Gardens, they have little more than *Herbs* for Soup and Salads, almoſt like thoſe in *Holland*.

The next Degree of *Gardens* for Profit, are the Nurſeries of Foreſt-Timber and Fruit-Trees; the chief for the firſt ſort, are thoſe about *Iſleworth*, *Twittenham*, and *Brentford*, which abound in thoſe neceſſary and uſeful Commodities. Mr. *Parker* at *Strand on the Green*, and Mr. *Green* of *Brentford*, raiſe yearly vaſt Numbers of every kind of *Tree* which is proper for the Improvement of Land. Nor are the Gardeners of this Nation leſs curious in cultivating of *Fruit-Trees*; ſo that I eſteem the Collections we have now in *England* to exceed all the Nurſeries in *Europe*, for profitable and uſeful Varieties; particularly that curious *Garden* of Mr. *Thomas Fairchild* at *Hoxton*, where I find the greateſt Collection of *Fruits* that I have yet ſeen, and ſo regularly diſpoſed, both for Order in time of ripening and good pruning of the ſeveral Kinds, that I do not know any Perſon in *Europe* to excel him in that particular; and in other Things he is no leſs happy in his Choice of ſuch Curioſities, as a good Judgment and univerſal Correſpondence can procure.

The curious Mr. *Green* at *Brentford* has alſo ſignalized himſelf in the Culture of ſome *Fruits*, and particularly the Pruning and Ordering of *Figs*, which are by his Method much forwarder, and in greater Quantity than I obſerve elſewhere in *England*; he has alſo cultivated in *Eſpalier* the *Bruxelles Abricots*, which affords a profitable Crop; but yet in the moſt perfect *Gardens* which I have obſerv'd in *England*, I am ſurpriſed that I have not found any Variety of *Figs*, exceeding the old Set of the *Blue Fig*, the *Early White*, the *Long White*, and one other Kind; for if we paſs but over to *France*, we find at leaſt fifty different ſorts of *Figs*, which afford as much Variety to the Taſte, as the *Peaches* or *Pears* we have upon our Liſts. There is one *Memorandum* I cannot avoid inſerting in this Place, relating to the different Kinds of *Fruit*, which at preſent croud the Nurſeries; were we to take all the ſorts we have Names for, we ſhould deſpiſe the greater part; and I believe, from what I have obſerv'd abroad, that there are no better *Fruits* there than we have already among us, becauſe I find little difference between the Liſts of our Nurſeries, and the *French* Liſts that are ſent over every Year from *Orleans*. For my own part, I have remark'd, that in *Devonſhire*, *Herefordſhire*, and ſome other Parts of *England*, the Seedling *Plants* rais'd from the *Kernels* of *Pears*, *Apples*, &c. continually afford Varieties of *Fruit*, very different from what we gather from thoſe *Plants* we had the *Seed* from. My curious Friend, *Samuel Reynardſon*, Eſq; of *Hillingdon*, near *Uxbridge*, has likewiſe raiſed ſeveral new Kinds of *Peaches* and *Grapes* from the *Stones* or *Kernels*; ſo that I ſee little Neceſſity for ſeeking out Varieties of *Fruits* in foreign Countries.

The third ſort of profitable *Garden* is the Phyſick *Garden*, where, beſides the Collection of *Herbs* uſed in Medicine, we commonly find ſome Variety of ſuch exotick Rarities from the hotter Climates, as afford the Curious ſufficient matter of Admiration. The firſt *Garden* of this kind that I have yet ſeen, is that at *Amſterdam*, which altho' it is not of great Extent, yet it affords the greateſt Choice of valuable *Herbs* and *Plants*, agreeable to its Deſign, of any *Garden* in *Europe*. The Method of it is the Claſſing of *Plants* in ſeveral Beds appointed for that purpoſe; upon which, the famous Profeſſors, Drs. *Comellin* and *Ruyſh*, read to the Citizens twice every Week; the firſt, upon thoſe which are *Exotick*, and the latter on the *Domeſticks*. The Governours of this *Garden* are the Chiefs of the City, who have a Delight in making it a Nurſery of ſuch *Plants*, as the Trade of their Country will give them leave to tranſport from the *Eaſt* to the *Weſt Indies*. An Inſtance of which is, that in the Year 1714, when I was there, they raiſ'd a conſiderable Number of *Coffee Trees* from *Seeds*, which ripen'd at *Amſterdam* upon two *Plants* that they firſt ſent from *Africa* to *Batavia*, and from thence to *Holland*; from whence they tranſported them to *Surinam* and *Curaſau*, ſuppoſing they might one Day bring forth profitable Crops that would yield Advantage to their Country; for theſe Places are ſo ſituate, that the Voyage to them is not a fourth of that to the *Eaſt Indies*, or a third to the *African* Coaſt, where *Coffee* grows: and if ever the *Dutch* ſhould loſe the Eaſtern *Coffee* Trade, or their *Eaſt Indian* Plantations, I expect that Drug will be chiefly brought to us from the *Weſt Indies*, where the *Hollanders* have planted it. 'Tis to the *Amſterdam* Phyſick *Garden* I owe the greateſt Part of that Collection of Curioſities which I once glory'd in; and to judge from what *Gardens* I have ſeen in *Europe* of this Order, I muſt do the *Amſterdam Garden* the Juſtice to own, that it exceeds all others in Variety of Curious and Uſeful *Plants*, from every Quarter of the World.

The next to the *Amſterdam Garden*, is the *Royal Garden* at *Paris*, where we may obſerve the Medicinal *Plants* ranged in exact Order, by the learned Dr. *Antoine de Juſſieu*, the King's Profeſſor of *Botany*. We find there likewiſe a good Collection of *Exotick* Curioſities diſpoſed after a good manner, and managed with excellent Skill; from whence I likewiſe drew ſeveral *Plants* that had not been ſeen before in *England.*

The Phyſick *Garden* at *Leyden* is what we may admire in the next place, for its good Order, and Variety of foreign *Plants*, under the Direction of the celebrated Dr. *Boorhave.* It is here I have found the greateſt Quantity of that extraordinary *Jeſſamine* of *Arabia*, whoſe *Flowers* excel all others in their Odour.

Among the Foreign Phyſick *Gardens*, I might yet mention that at *Piſa* in *Italy*, and the *Gardens* at *Florence* belonging to the Grand Duke of *Tuſcany*; from whence, by his Royal Highneſs's Direction, I have receiv'd valuable Preſents of choice *Plants*, rarely to be found in other *European Gardens.*

In *Britain*, our regular Phyſick *Gardens* are not above three in number; the beſt of which is that at *Chelſea*, belonging to the Company of *London* Apothecaries; where we may obſerve a great Variety of ſuch *Plants*, as are uſeful and entertaining to the Curious, as well *Exoticks* as *Domeſticks*: And after this, the Phyſick *Garden* at *Oxford* takes place in Reputation, from the Skill of the late learned Profeſſor Mr. *Jacob Bobart*, who had the Management of it. The Phyſick *Garden* at *Edinburgh*, according to the Account I have of it, is valuable for the Collection of uſeful *Plants* in Medicine; but I doubt the Climate in that Country is hardly generous enough to encourage the Growth of ſuch *Plants* as are Natives of the warmer Parts of the World.

To theſe we may add the curious *Gardens* of Particulars, which are famous for their Varieties of valuable *Plants*; the Chief of which in *England* are thoſe at *Badminton*, whoſe Rarities were collected by that incomparable Lady the Dutcheſs of *Beaufort*. The *Gardens* belonging to *Samuel Reynardſon*, Eſq;

at *Hillindon*, near *Uxbridge*; and the Collection at *Mitcham*, raiſed by Mr. *Du Bois*; and at *Cheame* in *Surrey*, by the Care and Skill of that excellent Flowriſt the Honourable *Lumley Lloyd*, D. D. with which we muſt alſo mention that numerous Collection made by the ingenious Mr. *Tho. Fairchild* at *Hoxton*, from every one I have yet named, both at home and abroad.

This is the Sum of our *Engliſh Gardens* for Curioſity, not to mention my own Collection, which, with more than ten Years Pains and Expence I got together; which is enough to ſupport the Spirit of *Botany*, and to which every Lover of that Science ought to addreſs himſelf, for his Satisfaction in the Knowledge of *Plants*.

But to make good the Title of this Chapter, I come now to ſpeak of *Fruit-Trees*; and firſt of all of the *Orange*, which this Year my worthy Friend Mr. *Curtes* of *Putney* has treated in a very particular manner, and has had that Succeſs, that I have learnt it is poſſible to have a graffed *Tree* or *Plant* of that kind in five or ſix Months, from the *Seed* or *Kernel*. I have obſerv'd in another Work, that the *Seed* of a *Lemon* will produce a *Plant* much more vigorous than that of an *Orange*, in the ſame ſpace of time; and therefore the curious Gentleman abovenamed uſed *Lemon* Stocks, rather than thoſe of *Oranges*; but not more than four Months from the *Kernel*, he cut the tender *Stems* of theſe Horizontally, about half an Inch above the *Ear-Leaves*, and ſlit it down about half an Inch, as in the Figure; and that his Deſign might be agreeable to the Laws of Nature, he prepared *Cions* of good bearing *Trees*, which were then tender in ſhoot, and conformable to the Strength and Age of the Stock, ſo as to anſwer the Bigneſs of it; and pruning the Lower End Wedge-wiſe, fix'd it in the prepared Stock, and tied it with Worſted, which takes little room, and is ſubſervient to Variety of Weather, by ſtretching or ſhrinking, as the Air alters its Property; over this Binding he puts a ſmall Quantity of graffing Wax, and in a few Days the *Stock* and *Cion* are join'd, and become as much one Body as other *Graffs* and *Cions* will do in two Months. As this will do in *Orange-Trees*, I doubt not but every other kind of *Fruit* may be as eaſily propagated, and then we ſhould enjoy this Satisfaction, that where a *Bud* or *Graff*, in the common Caſe, is hard to be got, we could anſwer our End as well by a tender growing Shoot. But the Excellency of this Diſcovery ſeems to open a new Field of Knowledge, which I ſhall examine into hereafter.

In the next place I come to enquire into the common Complaint of thoſe Gentlemen, who wait with Impatience for the bearing of the *Fruit-Trees* they have planted; and for that Reaſon I have contrived a Method, which I think will be ſatisfactory to them; and whereby there is not any Month in the Year, in which they may not plant their *Gardens*, but eſpecially their Walls, with any *Fruits* they deſire, by which Means they will not only gain two or three Years time, but may even bring their *Trees* into their *Gardens* with *Fruit* upon them, and ſo be ſatisfied they poſſeſs the Varieties they deſire.

To do this, I have engaged ſome Nurſery Men to provide a large Number of Boxes, whoſe Frame and Sides may be taken to pieces at pleaſure, each of theſe Boxes to meaſure eighteen Inches over, and as many in depth; in theſe I adviſe a Set of *Fruit-Trees* to be planted, of the beſt Kinds, and train'd up in the ſame manner that we uſe to thoſe *Trees* which are planted againſt Walls, giving them their regular Pruning from time to time, and directing their *Branches* and *Twigs* in the Poſture they ought to lie upon *Eſpaliers* made of *Arbour-poles:* When theſe *Trees* are brought to bear, we may tranſport them to any Diſtance with their Caſes, without injuring them; and be it at

what

Plate XXVIII.

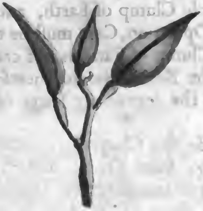


Fig. I.

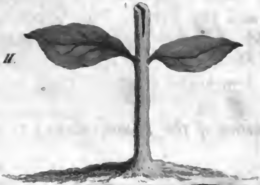


Fig. II.

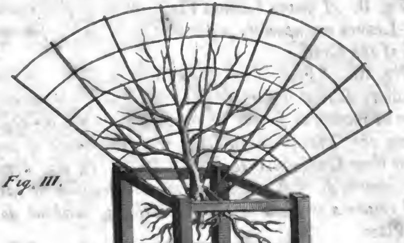


Fig. III.

what Seaſon it will, they may be ſet into the Ground at once, with their whole Clump of Earth, and without receiving any Injury. In this Operation, Care muſt be taken in taking off the Caſes, that the Clump of Earth is not crack'd or broken, leaſt the Air get in; the Bottom-board therefore muſt be interr'd with the *Tree*, and the remaining Parts of the Caſes may ſerve again.

To conclude this Chapter: I recommend the raiſing of all ſorts of *Flowers* from *Seeds*; and, I think, there can be no greater Motive to encourage our Gardeners to this Undertaking, than directing them to Dr. *Lloyd*'s of *Cheame*, Mr. *Dunklyn*'s at *Clapham*, and my Friends Mr. *Greenhill* at Mr. *Hunt*'s in *Putney*, and Mr. *Fairchild*, where they may obſerve wonderful Collections of *Flowers*, viz. *Ranuncules*, *Bulboſe Iris*, &c. lately raiſed from Seminaries diſcreetly made by thoſe Artiſts.

Explanation of the Plates relating to this Chapter.

Fig. I. *A* Cion *cut from a tender Shoot of the* Orange-Tree, *which is the youngeſt* Sprout *that could be cut from thence.*

Fig. II. *A young* Lemon Plant *in its firſt Growth, when the* Ear-Leaves *are upon it, agreeable to the Age, Strength, and Bigneſs of the* Graff.

Fig. III. *A* Fruit-Tree *planted in a* Caſe, *and trained up in* Eſpalier, *ſo that it may be planted aganſt a Wall at any Seaſon, even in* Flower *or* Fruit, *in the Situation we deſire, without injuring the* Tree; *deſign'd for the Advantage of ſuch as cannot plant their* Gardens *at their own time. In this Figure the* Caſe *is ſo contriv'd, that it may upon this Occaſion be taken to pieces, and return'd to the Place it came from, without doing Hurt to the* Plant.

CHAP.

CHAP. XVII.

Of VINES, *the beſt Method of Pruning them*; *with ſome proper Hints for ſuch as delight in raiſing forward* FRUITS.

ALTHO' I have treated of the Culture of *Vines* in another Work; the Opportunities I have had ſince of making Obſervations on the Management of *Vines* in *France*, gives me Occaſion to mention ſome Improvements which are pleaſant and profitable, and may greatly forward the Ripening of that delicious *Fruit* in *England*.

It is obſervable, that every *Vineyard* in *France* chiefly depends on the *Fruit* produced by Annual Layers; for the *Fruits* they bear are much larger, and ripe earlier, than what we find growing upon the old *Stocks*, whoſe greateſt Uſe is to yield *Branches* for the Layers of another Year. This leads us to judge of the Method of managing our Wall *Vines*, and directs us to preſerve the young Wood for the ſake of large and good *Fruit*. It is therefore improper to build an high Wall for *Vines*, becauſe all old Wood ſhould be taken away, and the moſt Vigorous of the young *Shoots* left at due Lengths for a Crop; and in this caſe we muſt have regard to the Subſtance of the Wood we preſerve: A *Branch*, for Example, whoſe Diameter is about half an Inch, may be left a Yard long; a *Branch* of one third of an Inch in Thickneſs, about two Foot; and ſo in Proportion; and at the ſame time, in convenient Places, two or three *Buds* muſt be kept to ſupply *Branches* for the following Year.

This Summer I conſider'd further of the Method of raiſing *Vines*; and among many Experiments I made, I found one, which, I think, will be of extraordinary Uſe, by giving us that Satisfaction which we have long wanted, of planting Sets, or Cuttings of *Vines*, all the Summer Seaſon; ſo that where we are ſure of a *Grape* we like, we may at any time propagate as many of that ſort as we pleaſe.

In *May*, which is the Month when thoſe Gardeners who have pruned unskilfully, are obliged to diſmember their *Vines* of the crouding *Branches*, which begin to bud out, we may plant every *Shoot* they pull off with the ſame Succeſs that we are uſed to make Nurſeries of 'em in *November*, *December*, or any of the Winter Months. In this Practice we muſt cover the Part that is to be interr'd with common ſoft Soap; and from a *Shoot* thus managed, we are ſure of a ſtrong *Plant* before the colder Seaſons reach us, as I have experienc'd. By this Method we learn two Things, firſt, that Soap is of excellent Uſe to the Improvement of the Growth of *Vines*; and in the next place, that we may gain a Year by this new Diſcovery: And from the whole I gather thus much, that Soap is the beſt Manure for *Vines* in general.

I next come to deſcribe thoſe Methods now in Uſe for producing of forward *Fruits*, by means of artificial Heats, ſuch as *Coal* or *Wood-Fires*, or *Horſe-litter*. The firſt is by building Ovens at certain diſtances at the Back of the Walls, and keeping them continually warm, from *January*, till the Sun's Power is ſufficient of it ſelf to maintain the Growth of the *Plants* growing againſt ſuch Walls, as it is now practis'd at his Grace the Duke of *Rutland*'s, at *Belvoir Caſtle*, whereby the lateſt Kinds of *Grapes* are commonly ripen'd about *July*, or *Auguſt*; but in this Method we muſt likewiſe take notice, that during the cold Seaſon, when theſe *Fruits* are forced to ſhoot unſeaſonably, the *Plants* muſt be cover'd with Glaſſes, to prevent the Injuries they might receive from Froſts.

But the Method which Mr. *Millet* takes to force *Cherries*, *Abricots*, and ſome other Kinds of *Fruit*, I take to be much the cheaper way, which is by building a Pale of five or ſix Foot high, compoſed of Deal-boards an Inch thick, cloſely jointed, on the South of which he nails his *Trees*; and about *December* lays a Coat of Horſe-Dung to the Back, about three Foot thick at the Baſe, ſloping, to about a Foot and half at the Top, which for about ſix Weeks ſtrikes a Warmth thro' the Boards, ſo agreeable to Vegetation, that the *Plants* bloſſom and diſpoſe themſelves to bear *Fruit* in great Abundance. Here I muſt obſerve, that when the Weather is moderate, he gives them what Air he can, by properly opening the Glaſſes which ſtand before them; and that when the Litter at the Back of the Pale has loſt its Heat, he renews it from time to time, till the Seaſon becomes natural to the Growth of *Trees*.

Having given my Readers what I at firſt propoſed, *viz. A Philoſophical Account of ſome Works of Nature*, in the *Mineral*, *Vegetable*, and *Animal* Parts of the *Creation*, in as many Inſtances as Time would admit for the neceſſary Experiments, &c. I am now to inform them, that as this Eſſay ſhall give Satisfaction, and the Author receive Encouragement in his Undertaking, more of his Time ſhall be employ'd towards carrying on a Work ſo uſeful to Mankind, which, by degrees, may frame a general and compleat Body of Experimental Natural Philoſophy.

FINIS.

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I. THE Hiſtory of *Succulent Plants*, containing the *Aloes*, *Ficoids*, (or *Fig-Marigolds*) *Torch-Thiſtles*, *Melon-Thiſtles*, and ſuch others as are not capable of an *Hortus-Siccus*. Engrav'd from the Originals on Copper-Plates; with their Deſcriptions, and Manner of Culture. By *R. Bradley*, F. R. S.

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